UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES, AND
TOXIC SUBSTANCES

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MEMORANDUM

SUBJECT: Revised EFED's RED document for thiophanate-methyl and its major degradate, MBC (methyl 2-benzimidazolycarbamate)

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Attached is a copy of the the RED document for thiophanate-methyl and its major degradate, MBC, which has been revised by taking into account the comments raised by Alf Atochem. The revised copy also incorporates the new application rate information and some new input parameters used in environmental fate modeling.

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EXECUTIVE SUMMARY

Thiophanate methyl, ((1,2-phenylene)bis(iminocarbonothioyl)) bis(carbamate) or (TM)), is a systemic fungicide that is absorbed by sprouts, leaves, and roots of plants and translocated within the transpiration system in plant xylem. Thiophanate methyl is used on many types of crops. For this risk assessment, one crop was selected to represent all crops within a specific group. The selection of these individual crops was based on their high frequency of use and application rate. The individual crops are expected to provide the highest EEC's for the crop groups they represent. These representative crops (excluding wheat) and the corresponding crop group include the following:

Peaches	-	Representative of tree crops (almonds, apples, nectarines, cherries, peaches, pecans, plums, prunes and apricots)
Soybeans	-	Representative of agronomic row crops (snap bean and dry-type)
Onions	-	Representative of vegetable crops (celery, cucumber, peanuts, potato-white/irish, pumpkin)
Turf	-	Representative of golf courses and lawns
Ornamentals	-	Representative of shade trees, lawn/recreation area lawn and turf, nonflowering plants, sod farms, woody shrubs and vines)

The rapid rate of degradation of thiophanate-methyl (TM) to the primary degradate methyl 2-benzimidazolylcarbamate (MBC) on foliage and in water along with the persistence of MBC in water are key factors that influence acute and chronic risks to ecological organisms and exposure to humans from ingestion of drinking water. Because of the rapid degradation of TM to MBC and the persistence of MBC in soil and water, acute risks to terrestrial and aquatic organisms are assessed based on the assumption that exposure is primarily to TM and chronic risks to terrestrial and aquatic organisms are assessed based on the assumption that exposure is primarily to MBC.

An Environmental Fate model, Ell-Fate Version 1.1, (referred to herein as the Environmental Fate model) was used to estimate exposures and risks to birds and mammals. The Environmental Fate model assumes exponential decay of pesticide following each application. The foliar dissipation half-life is a key input parameter for the Environmental Fate model used to estimate exposures and risks to birds and mammals. Limited dislodgeable foliar residue (DFR) data were available to determine the foliar dissipation half-life of TM, but not MBC. In the absence of foliar dissipation data, the default value of 35 days is used for TM and MBC. This value is based on maximum foliar dissipation half-lives of the most persistent pesticides for which such data are available. DFR data for TM and MBC for additional crops, locations, and time periods during the growing season would reduce uncertainty associated with these foliar dissipation half-lives for TM and MBC.

Although TM is practically nontoxic to birds at levels up to 10,000 ppm and to mammals at levels up to 5,000 ppm, estimated chronic hazards and risks to birds and mammals based on exposure to MBC are quite high. When TM is applied at the maximum annual label application rates and frequencies, estimated chronic risks to birds that consume food items other than seeds (i.e., short grass, tall grass, broadleaf insects and plants) are particularly high for turf and ornamentals and to a lesser extent, peaches in the southeastern United States.

Estimated chronic risks to mammals that consume food items other than seeds are particularly high for TM applied to turf and ornamentals at the maximum annual label application rates and frequencies. For ornamentals, the estimated risks are high even with a single application at the maximum annual label rate. The estimated chronic risks for small mammals (i.e., 15-gram and 35-gram body weight) tend to be several-fold higher than for large mammals (i.e., 1000-gram body weight).

The GENEEC and PRZM/EXAMS models were used to determine Estimated Environmental Concentrations (EECs) in surface water. These EECs are used with data on acute and chronic toxicity endpoints to estimate acute and chronic risks to aquatic organisms. EECs from GENEEC were used for turf and ornamental scenarios since inadequate input data were available to run these scenarios with PRZM/EXAMS.

TM is slightly to moderately toxic to aquatic organisms on an acute exposure basis. Although no estimated acute risk levels of concern, based on a risk quotient of 0.5, were exceeded for freshwater fish and invertebrates and estuarine and marine fish, estimated acute endangered species levels of concern, based on a risk quotient of 0.05, and acute restricted use levels of concern, based on a risk quotient of 0.1, were exceeded for three annual aerial applications of TM to turf, three annual ground applications of TM to turf, and three annual ground applications of TM to ornamentals. For estuarine and marine invertebrates, estimated acute high risk levels of concern were exceeded for aerial and ground applications to turf and ground applications to ornamentals at the maximum application rate and frequency listed on the TM label.

At maximum annual label application rates and frequencies, estimated chronic levels of concern, based on a risk quotient of 1.0, were exceeded for freshwater fish and invertebrates as well as estuarine and marine fish for all crops and locations modeled. At maximum annual label application rates and frequencies, estimated chronic levels of concern were exceeded for estuarine and marine invertebrates for aerial and ground applications to turf, ground applications to ornamentals, ground applications to onions, and aerial applications to peaches.

Estimated acute risks to aquatic plants were exceeded based on application of TM to turf and ornamentals at the maximum application rate and frequency listed on the TM label. Methods are not currently available to assess chronic risks to aquatic plants. Information required to assess acute and chronic risks to terrestrial plants is not available.

Under most agricultural conditions, TM entering the aquatic environment is expected to convert rapidly to MBC. MBC is very persistent but immobile in sandy loam or silt loam soils. It is likely that MBC will remain in the upper soil profile of these and similar soils. However, MBC has potential to leach to groundwater in highly sandy soils with low organic matter. The conversion of TM to MBC is somewhat slower on leaf surfaces and is expected to persist based on limited DFR data that predict foliar dissipation half-lives for apples ranging from 3.8 to 31.4 days. Volatilization from soil is not expected to be a significant dissipation mechanism for TM or MBC.

No data on monitored concentrations of TM or MBC were found in surface water or ground water. Neither TM nor its primary degradate, MBC, are regulated under the Safe Drinking Water Act. As a result, neither Maximum Contaminant Levels (MCLs) nor drinking water health advisories (HAs) for these chemicals have been established by the EPA Office of Water.

In the absence of monitoring data for TM and MBC in surface water, EECs of TM and MBC in surface water are based on modeling. The Tier II PRZM/EXAMS model was used to estimate surface water concentrations from use of TM at maximum application rates and frequencies listed on the product label for soybeans, peaches, and onions. Estimated peak concentrations of TM in surface water ranged from 11.6 to 50.4 ppb and estimated 60-day average concentrations of TM in surface water ranged from 0.84 to 9.09 ppb.. Peak and 60-day average concentrations of the primary degradate of TM, MBC, were also estimated from PRZM/EXAMS for soybeans, peaches, and onions. Estimated peak concentrations of MBC in surface water ranged from 15.7 to 208 ppb and estimated 60-day average concentrations ranged from 10.4 to 131 ppb.

Surface water concentrations of TM and MBC for turf and ornamentals were modeled using GENEEC rather then PRZM/EXAMS because standard values for input parameters for these crops have not been developed. Estimated peak TM EECs from use of TM at maximum application rates and frequencies listed on the TM label for turf and ornamentals ranged from 2130 to 3220 ppb and estimated 56-day average TM EECs ranged from 1120 to 1710 ppb. Peak MBC EECs from use of TM at maximum label application rates and frequencies for turf and ornamentals ranged from 1360 to 1610 ppb and estimated 56-day average MBC EECs ranged from 610 to 730 ppb.

In the absence of monitored levels of TM and MBC in ground water, the SCI-GROW model was used to estimate the potential ground water concentrations for ornamentals, the crop with the highest application rate listed on the TM label. Estimates of ground water concentrations based on the SCI-GROW model indicate that application of TM at maximum label rates is unlikely to result in concentrations that exceed a 90-day average concentration of 0.111 ppb for TM and 10.1 ppb for MBC.

INTRODUCTION

Thiophanate methyl ((1,2-phenylene)bis(iminocarbonothioyl)) bis(carbamate) or (TM)) is a systemic fungicide that is absorbed by sprouts, leaves, and roots of plants and translocated within the transpiration system in plant xylem. TM and it's primary degradate, MBC (Methyl 2-benzimidzolylcarbamate or Carbendazim), inhibit the development of fungal germ tubes, the formation of appressoria, and the growth of mycelia. Their fungitoxic action is based on blockage of nuclear division during mitosis and destabilization of fungal cell structures.

Thiophanate methyl is used on many types of crops. For this risk assessment, one crop was selected to represent crops within a specific group with the exception of wheat which was not included in the risk assessment. The selection of these individual crops was based on their high frequency of use and application rate. The individual crops are expected to provide the highest EEC's for the crop groups they represent. These representative crops (excluding wheat) and the corresponding crop group include the following:

Peaches	-	Representative of tree crops (almonds, apples, nectarines, cherries, citrus, peaches, pecans, plums, prunes and apricots)
Soybeans	-	Representative of agronomic row crops (snap bean and dry-type)
Onions	-	Representative of vegetable crops (celery, cucumber, peanuts, potato-white/irish, pumpkin)
Turf	-	Representative of golf courses and lawns)
Ornamentals	-	Representative of shade trees, lawn/recreation area lawn and turf, nonflowering plants, sod farms, woody shrubs and vines)

Methyl 2-benzimidzolylcarbamate (MBC) residues can be present as a result of the use of Thiophanate methyl (TM), Methyl-1-(butylcarbamoyl)benzimidazol-2-ylcarbamate (Benomyl), and direct application of MBC as Carbendazim. MBC, a degradate of TM and Benomyl, is also itself a registered fungicide. Benomyl, which may not be registered, is a foliar systemic fungicide, presently used as a 50% wettable powder on a variety of crops including vegetables, field crops, tree crops, and vineyards. Based upon data from studies that met Agency guidelines, Benomyl degrades rapidly to carbendazim (MBC) in soil and water. MBC is very persistent in water and very toxic to some fish and invertebrate species. TM and MBC are expected to persist on leaf surfaces and in leaf litter, and to accumulate with each successive application. This assessment is based on the presence of TM and its degradate, MBC, in the environment. There is a concern that TM and its degradate, MBC, could be present in ground and surface water.

For TM product information such as active product registrations, formulations, and use sites refer to the BEAD chapter. TM crops supported for preregistration are: Almonds, apples, dry beans, lima beans, snap beans, cucurbits, onions, peanuts, pecans, soybeans, apricots, cherries, nectarines, peaches, plums, prunes, strawberries, sugarbeets, potatoes (seed treatment only), turf, greenhouse and interiorscape, landscape, and nursery. Revoked uses include celery, post harvest uses of all commodities, sugarcane, and bananas.

ENVIRONMENTAL FATE AND TRANSPORT ASSESSMENT

SUMMARY

Thiophanate methyl degrades primarily to Carbendazim (MBC) whether on foliage, in soil, or in water. Both photolysis and hydrolysis are important routes of degradation. While the TM degradation rate is slower on foliage than in the aquatic environment conversion to MBC is expected to be rapid under most normal agricultural conditions.

Based on data from studies that meet Agency guidelines, MBC is stable to aqueous photodegradation, stable to hydrolysis at pH values ranging from 5 to 7, with hydrolytic stability decreasing within this range of pH values as pH increases, and stable to soil photolysis. Metabolism under aerobic and anaerobic conditions in both soil and water proceeds at a very slow rate.

TM degrades relatively easily in soil and is expected to be mobile. MBC has the potential to leach on sandy soils with low organic matter content. Otherwise, MBC is unlikely to leach through the soil column.

FATE IN WATER

Based on environmental fate studies for thiophanate-methyl that meet Agency guidelines, the hydrolytic stability of TM decreases with increasing pH and temperature. Whereas TM is stable to hydrolysis at pH 5.0 and hydrolyzes with a half-life of 36 days at pH 7.0, TM rapidly hydrolyzes at pH 9.0 with a half-life of 0.7 days. The primary degradates of hydrolysis formed at variable amounts during the study were MBC, and AV-1951 (refer to Appendix 1 for formulas). The amount of degradates increased with time. MBC was always found at higher concentrations than AV-1951 at all sampling intervals (MRID# 40095507).

The photodegradation half-life of TM in water is 0.53 days in summer, 0.66 days in spring, and 2.48 days in winter (MRID# 41482806). Three photodegradates were identified; the major degradate, MBC, and minor degradates, DX-105 and FH-432 (refer to appendix 1 for formulas). The solubility of TM in water is 21.8 ppm at pH 7 and 25 ^{0}C (MRID# 41482806).

Based on environmental fate studies that meet Agency guidelines, MBC is stable to hydrolysis at pH 5 and 7, with hydrolytic stability decreasing within this range of pH values as pH increases. MBC was also found to be stable to aqueous photolysis at a pH of 5. MBC has a solubility in water of 8.0 ppm at pH 7 and 25 ^{0}C (MRID 00151418 and MRID 00151419).

MBC degraded with an estimated half-life of 61 days in a clay loam:water system at pH 7.3 incubated aerobically for 30 days (MRID# 41291501). Extrapolating results beyond the duration of the study introduces uncertainty into the estimated half-life.

Anaerobic aquatic metabolism

The anaerobic aquatic metabolism half-life of TM is less than 1 day. The major degradate was MBC, being present at 66 percent of TM initially applied after 1 day in the water phase. The amount of MBC declined over time. However, adequate sampling intervals were not established to estimate an MBC half-life from this study. The degradates, AV-1951, DX-105, and FH-432, were also detected, particularly in the aqueous phase during the first week at less than 10 percent of TM initially applied. No degradates were detected in the aqueous phase after 12 months. However, DX-105 and FH-452 were detected in soil 12 months after application (MRID# 40061501).

In a study where MBC was followed in a clay loam:water system at pH 7.4 and anaerobically incubated for 365 days, an extrapolated half-life was established at 743 days (MRID# 41137701).

FATE IN SOIL

Photodegradation in soil

TM in soil photodegraded with natural sunlight at half-lives ranging from 2.9 to 5.5 days. In dark conditions, the half-lives for TM in a sandy loam soil with pH 7.4 at 1.7 percent organic matter range from 10.3 to 19.3 days. Degradates were MBC and DX-105. Although no information on photodegradation of these degradates in soil was available, degradates are believed to be bound to soil more readily than TM (MRID# 42094601).

MBC is stable to photodegradation in soil (ACC. 00151420). At the end of a 32-day study, MBC represented greater than 99 percent of the initially applied radioactivity. The study duration was insufficient, however, to establish a pattern of decline or estimate a half-life.

Aerobic soil metabolism

The aerobic soil metabolism half-life of TM in soil is less than 1 day. The major degradate identified was MBC, with bound residues in a soil of pH 7.5 present after 12 months at 76 percent of the levels at application. Other degradates detected were FH-432 and DX-105 at less than 10 percent of the initially applied radioactivity. Maximum radioactivity reached 82.7 percent of the applied during the first three weeks after treatment with gradual but slow decline thereafter (MRID# 00106085).

MBC degraded with a half-life of 320 days (MRID# 41255801). In this study, MBC reaches a maximum total of 41.8 percent of the radioactivity by the 30th day after treatment, with gradual but slow decline thereafter.

Leaching, adsorption/desorption of TM and degradates

TM, MBC, DX-105 and FH-432 sorbed relatively poorly to a series of six different soils. The adsorption was such that MBC sorbed more strongly (K_{oc} 2100) than TM and the remaining degradates (lowest K_{oc} 117.7) which were approximately equivalent in their sorption profile. MBC was tightly bound to the humin (soluble and insoluble) and fulvic acid soil fractions. TM, DX-105 and FH-432 all readily desorbed from the test soils indicating a high likelihood to be very mobile in soils. MBC did not desorb as readily, therefore, is less likely to be mobile in soils with similar characteristics (MRID# 42351001, ACC# 00151421 and ACC# 00151422). A soil column leaching study that meets Agency guidelines indicates that MBC is relatively immobile, with greater than 95 percent of the amount initially applied remaining in the upper 4 inches of the soil column (ACC# 00151421).

Terrestrial field dissipation

Dissipation of TM residues from soil is rapid, with dissipation half-lives up to 4.2 days and formation of MBC and Dimethyl-4,4'-o-phenylenebis (i.e., allophanate) as degradates. Dissipation half-lives calculated for MBC ranged from 22 to 94 days in 3 studies (MRID# 41930101, 41930102, 43433701).

MBC dissipated in loam soil at a rate corresponding to a half-life of 86 days and from sand soils at a rate corresponding to a half-life of 15 days. MBC was detected in the top 15 cm horizon of both soils (MRID# 43941301). In general, these half-lives were relatively short compared to the laboratory biotic and abiotic studies. Recoveries during the studies were good indicating acceptable mass balances of MBC. Site parameters such as slope and climatology may have influenced the more rapid dissipation of MBC in the field than was observed in the laboratory studies.

FATE ON FOLIAGE

The conversion of TM to MBC is expected to be a slower process on foliage than in water. Based on dislodgeable foliar residue (DFR) studies that were evaluated by the Health Effects Division (HED), the foliar dissipation half-life of TM applied to apples and strawberries was determined to be as long as 31.4 days. TM applied to apples in New York dissipated with a half-life of 3.8 days, whereas TM applied to apples in Washington dissipated with a half-life of 31.4 days (MRID# 44876301). In this study, residue levels of MBC were not reported. The difference in dissipation half-lives of TM applied to apples in New York compared to TM applied to apples in Washington can be explained by the difference in the amount of precipitation at the two sites. The apple orchard in the town of Quincy, WA, located east of the Cascades mountain range, is characterized by dry climate and low precipitation, whereas the apple orchard in New York is characterized by wet climate and high precipitation. Thus, increased wash-off may have contributed to the more rapid dissipation observed in New York. It is hypothesized that photolysis may have had little effect on dissipation of TM from apples due to “shading”. In this context, “shading” refers to the effect of leaf surfaces in the upper portion of a tree inhibiting light penetration to leaf surfaces lower on the tree. On the other hand, TM applied to strawberries in NC dissipated with a half-life of 1.08 days for combined TM and MBC residues. TM applied to strawberries in the Central Valley of California dissipated with a half-life of

1.78 days for combined TM and MBC residues (MRID#44866201). Because of the highly exposed surfaces of strawberries relative to apples, “shading” effects are less likely to occur thereby leading photolysis to be a more influential pathway for disappearance of TM on strawberries than on apples in an orchard. No foliar dissipation data for TM or MBC are available.

Supplemental information from the World Health Organization (WHO) (Report No.: 133 (Pesticide Residues In Food - 1995, Geneva, Switzerland, page 187, 9/16/95-9/27/95)) indicates that TM residues have been detected in TM-treated produce.

WATER RESOURCES ASSESSMENT

SURFACE WATER

No data on monitored concentrations of TM itself and of MBC from Thiophanate-methyl, Benomyl, or Carbendazim itself in surface water were found. Therefore, Tier I and Tier II surface water models were used to estimate surface water concentrations of TM and its primary degradate, MBC.

PRZM/EXAMS was used to estimate surface water concentrations from use of Thiophanate-methyl on soybeans, onions, and peaches. Surface water concentrations for turf and ornamentals were modeled using GENEEC rather than PRZM/EXAMS because standard values for input parameters for PRZM/EXAMS for these scenarios (i.e., turf and ornamentals) have not been developed. Given the relatively rapid formation of the primary degradate of TM, MBC, surface water concentrations of MBC were also estimated. The maximum amount of MBC formed from Thiophanate-methyl is approximately 82.7 percent of TM initially applied based on results from the aerobic soil metabolism study (MRID #106085). Therefore, a conservative application rate of MBC was estimated based on the product of (1) the application rate of TM; (2) the maximum conversion of TM to MBC (i.e., 0.827); and (3) the molecular weight ratio of TM to MBC for mass balance on molar bases (i.e., 0.56).

Tier I Surface Water Modeling

GENEEC, a Tier I surface water model, was used to determine the estimated environmental concentrations (EECs) of TM and MBC in surface water as a result of application of TM to turf and ornamentals. The Tier I model is used to screen pesticides to determine those that potentially pose a risk and warrant closer examination using additional and more specific information on input values that pertain to climate, soil characteristics, and application characteristics for a specific use. GENEEC is intended to provide an estimate of the upper-bound concentration of pesticide in surface water that might result from application of a pesticide at or in the vicinity of ecologically sensitive environments. GENEEC estimates surface water concentrations from both runoff and spray drift from a 10 hectare field immediately adjacent to a 1 hectare pond that is 2 meters deep and has no outlet. The contribution of pesticide from runoff is estimated based on a single application of pesticide followed by a storm event that causes runoff of 10 percent of the applied pesticide into the adjacent pond. The contribution of pesticide from spray drift, however, is estimated based on spray drift that is associated with each application of pesticide. Data on fate processes such as hydrolysis in water, photolysis in soil, aerobic soil metabolism, and aerobic water metabolism are considered in GENEEC in estimating resulting surface water concentrations. In addition, data on sorption of pesticide onto soil are also accounted for in estimating surface water concentrations. Table 1 presents values for input parameters used in the GENEEC model to estimate concentrations of TM and MBC in surface water as a result of application of TM to turf and ornamentals.

Table 1. TM and MBC input parameters used in GENEEC model.		
Chemical	**TM**	**MBC**
PC Code for parent chemical	102001	128872
Solubility (ppm)	21.8	8
Hydrolysis half-life, pH 7 (days)	36	stable
Soil Photolysis half-life (days)	2.48	stable
Aerobic Soil Metabolism half-life (days)	1	320
Aerobic Aquatic Metabolism half-life (days)	N/A	61
Soil Organic Carbon Partitioning (K_{oc})(l/kg)	314*	1885**
Source of Data:	Guideline studies submitted under FIFRA	Guideline studies submitted under FIFRA
Quality of Data:	Variable but generally good	Variable but generally good
Use	Turf, Ornamentals	Turf, Ornamentals
Application Rate (lb a.i. /acre/yr) Turf Ornamentals	 76.6 100	 35.3*** 46.3***
Number Of Applications/year Turf Ornamentals	 6 3	 6 3
Application Method: Turf Ornamentals	 ground aerial	 aerial ground

*** Based on data from acceptable batch equilibrium study.**

**** Calculations based on data from an acceptable batch equilibrium study for MBC from benomyl.**

***** TM application rate X [(0.827, the maximum conversion rate from the degradation of TM to MBC in laboratory studies)x(0.56, the molecular weight ratio of MBC to TM)].**

The EECs for TM and MBC based on GENEEC modeling are presented in Table 2. The surface water concentrations to be used to estimate acute exposures and risks to TM and MBC are based on the value of the estimated initial maximum EEC (i.e., the peak modeled concentration). The surface water concentrations to be used to estimate chronic exposures and risks to TM and MBC are based on values of the estimated 56-day average EEC.

Table 2: EEC's (Fg/L) for TM and MBC from GENEEC model.						
	TM			MBC		
Use: Application frequency / Application Method	Acute: Peak EEC	Chronic: 21-day Average EEC	Chronic: 56-day Average EEC	Acute: Peak EEC	Chronic: 21-day Average EEC	Chronic: 56-day Average EEC
Turf: 6/ground	2130	1640	1120	1610	1120	730
Ornamentals: 3/aerial	3220	2500	1710	1360	950	610

Tier II Surface Water Modeling

The EECs generated from the Tier II analysis were estimated using PRZM (Pesticide Root Zone Model) version 3.12 to simulate runoff and erosion from an agricultural field and EXAMS (Exposure Analysis Modeling System) version 2.97.5 to estimate environmental fate and transport in surface water. Tier II estimated environmental concentrations (EECs) were modeled for Thiophanate-methyl and MBC from use of TM on soybeans, peaches, and onions. For each of these crops, the Tier II analysis is based on a single location that was selected to represent a typical upper-end scenario for the use of TM. Generally, weather and agricultural practices are simulated by the PRZM/EXAMS model over 36 years so that the 1 in 10 year annual return frequency at the representative location can be estimated. The 1 in 10 year annual return frequency corresponds to the 90^{th} percentile annual exceedance that was determined over the 36-year period that was modeled. The 90^{th} percentile annual exceedance is determined by ranking from highest to lowest the dissolved water column concentrations for each of the 36 years modeled and determining the 90^{th} percentile of these values. In most instances, the 90^{th} percentile falls between the values for two years. In these cases, the 90^{th} percentile value is obtained by interpolating between the values for those two years. In the case of beans from Michigan, the location for beans was modeled for only 24 years since weather data for that location were available for only 24 years.

A complete set of standard input values for dry bulb onions was not available. In the case of onions, input data were developed by modifying the San Joaquin Valley, CA grape scenario to reflect agricultural practices for onions. Data from the University of California-Davis Agricultural Extension Service regarding typical planting, maturity, and harvesting dates for dry bulb onions were used in place of such data for grapes.

Based on information provided on the TM label (No. 4581-372) submitted by the registrant, TM may be applied with ground or aerial equipment. For soybeans, and peaches, aerial application of TM was modeled since aerial application results in higher estimates of surface water concentrations than ground application. For onions, broadcast application of TM was modeled since, on the TM label, broadcast application was specified for onions. A partial list of input parameters for PRZM/EXAMS is presented in Table 3.

Table 3. PRZM/EXAMS input parameters for TM and MBC.

Parameter	TM	MBC
PC Code	102001	128872
Solubility (mg/L)	21.8	8
Hydrolysis Half-life @ pH 7 (days)	36	Stable
Photolysis Half-life (days)	2.48	Stable
Aerobic Soil Metabolism Half-life (days)	1	320
Aerobic Aquatic Metabolism Half-life (days)	N/A	61
Anaerobic Aquatic Metabolism Half-life (days)	1	743
Vapor Pressure (tor)	1.3E-5	7.5 E-10
Soil Organic Carbon Partition Coefficient (Koc) (L/kg)	314*	1885**
Mol. Wt (Merck Index)	342.4	191.18
Crops	peaches, soybeans, and onions	peaches, soybeans, and onions
Application Method: peaches, soybeans Onions	 aerial broadcast	 aerial broadcast
Application Rate (lb a.i/acre)*** /number of applications/interval between applications: soybeans/2/4 peaches/12/10 onion/1	 1.05 1.60 12	 0.49 0.74 5.6
Spray drift (%)	0.16 (aerial) 0.064 (broadcast)	0.16 (aerial) 0.064 (broadcast)

*** Based on data from acceptable batch equilibrium study.**

**** Calculated based on data from an acceptable batch equilibrium study for MBC from benomyl.**

***** TM application rate X [(0.827, the maximum conversion rate from the degradation of TM to MBC in laboratory studies)x(0.56, the molecular weight ratio of MBC to TM)].**

Table 4 presents the estimated 90th percentile annual peak and long-term 21-day and 60-day average concentrations of TM and MBC in surface water for peaches, soybeans, and onions based on the PRZM/EXAMS model.

Table 4. Estimated Peak and Long-term Average Concentrations of TM and MBC in Surface Water Based on the PRZM/EXAMS Model.						
Crop	**TM**			**MBC**		
	Peak (Fg/L)	**21-day Average (Fg/L)**	**60-day Average (Fg/L)**	**Peak (Fg/L)**	**21-day Average (Fg/L)**	**60-day Average (Fg/L)**
Peaches/GA 1.60 lbs.ai/A, 12 apps., 10 day interval	**34.4**	**13.2**	**9.09**	**85.4**	**72.2**	**67.5**
Soybeans/GA 1.05 lbs.ai/A, 2 apps., 4 day interval	**11.6**	**2.31**	**0.84**	**15.7**	**12.4**	**10.4**
Onions/CA 12 lbs.ai/A, 1 app.	**50.4**	**6.65**	**2.33**	**208**	**164**	**131**

GROUND WATER

No data were found on monitored levels of TM and MBC in ground water. In the absence of monitoring data, the SCI-GROW model was used to estimate potential ground water concentrations. The crop with the highest application rate, ornamentals, was modeled. Based on results from the aerobic soil metabolism study conducted for TM, the maximum amount of MBC formed from Thiophanate-methyl is approximately 82.7% of the initial radioactivity applied. Therefore, a conservative application rate of MBC was estimated based on the product of (1) the application rate of TM; (2) the maximum conversion of TM to MBC (i.e., 0.827); and (3) the molecular weight ratio of TM to MBC for mass balance on molar bases (i.e., 0.56). Ground water concentrations of TM and MBC were estimated for application of TM to ornamentals since the annual application rate of TM to ornamentals, 100 pounds of active ingredient per acre 3 times a year, represents the maximum annual application rate for all crops listed on the TM label. Values for input parameters and estimated ground water concentrations for TM and its primary degradate, MBC, based on application of TM to ornamentals are presented in Table 5.

Table 5: Values for Input Parameters and Estimated Ground Water Concentrations of TM and MBC from the SCI-GROW Model for TM Applied to Ornamentals.		
Parameter	**TM**	**MBC**
K_{oc} (l/Kg)	**314**	**1885**
Application Rate (lbs. a.i. acre^{-1})	**100**	**46.3**
Aerobic Soil Metabolism $t_{1/2}$ (day)	**1**	**320**
Number of Applications/year	**3**	**3**
Concentrations (Fg/L)	**0.111**	**10.1**

There may be circumstances under which ground water concentrations could exceed the SCI-GROW estimates. However, such circumstances are expected to be quite rare since the SCI-GROW model is based exclusively on maximum 90-day average ground water concentrations from studies conducted at sites and under conditions that are most likely to result in leaching of pesticides from soil into ground water. The ground water concentrations estimated by SCI-GROW are based on the highest 90-day average concentration recorded during the sampling period. Since there is relatively little temporal variation in ground water concentrations compared to surface water concentrations, the resulting concentrations from SCI-GROW are appropriate for both acute and chronic exposure durations.

RECOMMENDED DRINKING WATER CONCENTRATIONS

Ground Water

No data on monitored levels of TM or MBC were found. Neither Thiophanate-methyl nor it's primary degradate, MBC, are regulated under the Safe Drinking Water Act. Thus, neither Maximum Contaminant Levels (MCLs) nor drinking water Health Advisories (HAs) for these chemicals have been established by the EPA Office of Water. Results presented in Table 5 for TM and MBC based on the SCI-GROW screening model indicate that application of TM at maximum label rates is unlikely to exceed a 90-day average concentration of 0.111 Fg/L for TM and 10.1 Fg/L for MBC.

Surface Water

No data on monitored levels of TM or MBC were found. Therefore, modeling was used to estimate TM and MBC concentrations in surface water. Since standard values for input parameters needed to run PRZM/EXAMS were not available for turf and ornamentals, surface water modeling results for turf and ornamentals were based on Tier I modeling using GENEEC. Estimated peak concentrations of TM applied to turf and ornamentals ranged from 2130 to 3220 Fg/L and 56-day

average concentrations ranged from 1120 to 1710 Fg/L. Estimated peak concentrations of MBC resulting from application of TM to turf and ornamentals ranged from 1360 to 1610 Fg/L and 56-day average concentrations ranged from 610 to 730 Fg/L. PRZM/EXAMS was used to estimate concentrations of TM and MBC from application of TM to soybeans, peaches, and onions. Estimated peak concentrations of TM applied to soybeans, peaches, and onions ranged from 11.6 to 50.4 Fg/L and 60-day average concentrations ranged from 0.84 to 9.09 Fg/L. Estimated peak concentrations of MBC resulting from application of TM to these crops ranged from 15.7 to 208 Fg/L and 60-day average concentrations ranged from 10.4 to 131 Fg/L. Modeling results indicate that substantial amounts of MBC are potentially available for runoff to surface water for a long time following application of TM. If a runoff event occurs within 1 to 2 days after application of TM and if TM is transported into surface water via runoff and/or spray drift, TM will degrade rapidly, within days or less depending on water pH and location in the water column, to form MBC which is expected to be very persistent since it has been demonstrated to be stable to aqueous photolysis and hydrolysis at pH values of 5, 7, and 9.

TERRESTRIAL RISK ASSESSMENT

Terrestrial EECs for each crop considered in this risk assessment were determined using the Environmental Fate model (ELL-FATE). The Environmental Fate model estimates maximum and 56-day average concentrations of pesticide residues in food items consumed by birds and mammals and accounts for data regarding the half-life of the chemical being modeled. The half-life data required as input to the Environmental Fate model are, in order of preference, foliar dissipation half-life, hydrolysis half-life at pH 7, and a default half-life value of 35 days. This default half-life of 35 days is based on foliar dissipation data for some of the most persistent pesticides for which such data are available. The Environmental Fate model estimates EECs for four categories of food items consumed by birds and mammals: short grass, tall grass, broadleaf plants/Insects, and seeds. The Environmental Fate model also estimates risk quotients (RQs) from EECs, LC50 values, and NOAELs. The basis for LC50/LD50 and NOAEC values used in this risk assessment is discussed in Appendix 5: Ecological Effects Characterization. RQ estimates for mammals consider the fraction of body weight that the food item comprises. The fraction of body weight consumed is assumed to be 0.95 for a 15-gram mammal, 0.66 for a 35-gram mammal, and 0.15 for a 1000-gram mammal.

The EECs from the Environmental Fate model are based on predicted day-0 maximum and mean residues following a single application of 1 pound of active ingredient per acre. These initial concentrations are based on work done by Hoerger and Kenaga (1972) as modified by Fletcher et al. (1994). The Environmental Fate model adjusts these predicted mean and maximum residue values by the application rate and annual frequency of application for the crop being modeled and assumes exponential decay following each application of pesticide at a rate based on the half-life data provided for the pesticide being modeled. For additional information on the predicted mean and maximum residue values on which the Environmental Fate model is based, please refer to Appendix 6: A Table of "Estimated Environmental Concentrations on Avian and Mammalian Food Items (ppm) Following a Single Application at 1 lb ai/acre". This table is derived from the Kenaga Nomogram, revised by: Fletcher, J.S., J. E. Nellessen, and T.G. Pfleeger. 1994. "Literature Review and Evaluation of the EPA Food-chain (Kenaga) Nomogram, An Instrument For Estimating Pesticide Residues On Plants". Environmental Toxicology and Chemistry, Vol. 13 (9): 1383-1392.

The Virginia Spray Bulletin 456-419 (Pfeiffer, 1992) recommends up to 8 cover sprays for fungicides and up to 10 for insecticides for fruit trees. This risk assessment has assumed 12 applications of TM to peaches annually (i.e., 4 pre-cover and 8 cover sprays) as opposed to using an unlimited number of total applications. The definition of "cover sprays" in this case could conceivably result in a spray every 7 days until just before harvest, corresponding to a period that would allow up to 16 to 18 applications of TM per growing season.

For the purpose of this risk assessment, EECs were estimated for both TM and its primary degradate, MBC. Based on environmental fate data for TM and MBC, it appears as though TM degrades fairly rapidly in the terrestrial environment to form MBC. As a result, acute effects to terrestrial organisms were assumed to result primarily from TM and chronic effects were assumed to result from MBC. Consequently, estimated acute risk quotients were derived from LC50 and EEC

values for TM and chronic risk quotients were derived from NOAEL and EEC values for MBC. The half-life used to determine terrestrial EECs and RQ values for TM and MBC were assumed to be 35 days, a default used in the absence of foliar dissipation half-life data for this chemical. The maximum amount of MBC formed from Thiophanate-methyl is approximately 82.7 percent of TM initially applied based on results from the aerobic soil metabolism study (MRID #106085). Therefore, a conservative application rate of MBC was estimated based on the product of (1) the application rate of TM; (2) the maximum conversion of TM to MBC (i.e., 0.827); and (3) the molecular weight ratio of TM to MBC for mass balance on molar bases (i.e., 0.56). The resulting application rate for MBC was used as an input value for the Environmental Fate model (ELL-FATE).

ESTIMATES OF RISKS TO BIRDS

Table 6 presents estimated peak TM EECs, peak and 56-day average MBC EECs, acute TM RQs, and MBC chronic risk quotients based on peak and 56-day average MBC EECs for birds by type of forage for each crop examined in this risk assessment. The acute risk quotients are based on the assumption that the bird species tested, the mallard duck, is representative of all birds and that the LC50 value determined for the mallard duck is applicable to all bird species. Although data for the bobwhite quail are required, these data were not available. **It must be noted that the LC50 value for TM determined for the mallard duck was greater than 10,000 ppm, a level considered practically non-toxic to birds. For the purpose of estimating acute risk quotients, the LC50 value for TM was assumed to be 10,000 ppm. Consequently, the resulting acute risk quotients are maximum estimates.** (Refer to Appendix 6 for a more detailed discussion of ecological organism Levels Of Concern (LOC's) and Appendix 8 for caveats associated with assessing risks to birds). Based on these assumptions, the acute endangered species level of concern (LOC) based on an RQ of 0.1 was estimated to be exceeded when TM is applied at the maximum application rates listed on the product label under the following circumstances:

- twelve annual aerial applications to peaches
- six annual aerial applications to turf;
- one and three annual ground applications to ornamentals; and
- one annual ground application to onions.

In addition, the acute restricted use LOC based on an RQ of 0.2 was estimated to be exceeded when TM is applied at the maximum annual application rates listed on the product label under the following circumstances:

- six annual aerial applications to turf;
- one and three annual ground applications to ornamentals; and
- one annual ground application to onions.

Furthermore, the acute LOC based on an RQ of 0.5 was estimated to be exceeded when TM is applied at the maximum annual application rates listed on the product label under the following circumstances:

- six annual aerial applications to turf;
- one and three annual ground applications to ornamentals

Chronic risk quotients based on peak MBC EECs estimated from the Environmental Fate model are estimated to exceed the Chronic LOC for birds based on an RQ of 1.0 for most sites, application rates, and frequencies considered in this risk assessment for birds that consume short grass. Furthermore, risk quotients based on 56-day average EECs estimated from the Environmental Fate model are estimated to exceed the chronic LOC for all crops considered with the exception of soybeans. Consumption of short grass leads to the highest chronic risk estimates for birds, with successively lower risks estimated for birds that consume broadleaf plants/insects, tall grass, and seeds.

TABLE 6. Avian Acute and Chronic Risk Quotients Estimated from the Environmental Fate Model for Application of Non-granular Products Based on a Mallard Duck LC50 of > 10,000 ppm, a Mallard Duck NOAEC of 103 ppm, a TM and MBC half-life assumed to be 35 days

Crop/App. Method	TM /MBC Application Rate in lbs AI/acre/ (Annual Frequency of applications)	Food Items	Peak TM EEC (ppm)	Acute TM RQ (Peak TM EEC / LC50)	Peak / 56-day average MBC EEC (ppm)	Chronic MBC RQ (56-day average MBC EEC / NOAEC)	Chronic MBC RQ (Peak MBC EEC / NOAEC)
Peaches / aerial	1.60 / 0.74 (1)	Short grass	384	< 0.04	178 / 108	1.05	1.70
		Tall grass	176	< 0.02	81 / 50	0.49	0.79
		Broadleaf plant/Insect	216	< 0.02	100 / 61	0.59	0.97
		Seeds	24	< 0.01	11 / 7	0.07	0.11
Peaches / aerial	1.60 / 0.74 (12)	Short grass	1,939	< 0.19	897 / 415	4.03	8.71
		Tall grass	889	< 0.09	411 / 190	1.84	3.99
		Broadleaf plant/Insect	1,091	< 0.11	504 / 233	2.26	4.90
		Seeds	121	< 0.01	56 / 26	0.25	0.45
Soybean / aerial	1.05 / 049 (1)	Short grass	252	< 0.03	12 / 7	0.07	0.11
		Tall grass	116	< 0.01	5 / 3	0.03	0.05
		Broadleaf plant/Insect	142	< 0.01	7 / 4	0.04	0.06
		Seeds	16	< 0.01	1 / 0.5	0.00	0.01
		Tall Grass	75	< 0.01	34 / 21	0.20	0.33
		Broadleaf plant/Insect	92	<0.01	42 / 26	0.25	0.41
		Seeds	10	<0.01	5 / 3	0.03	0.05
Turf / ground	76.6 / 35.5 (6)	Short grass	61,538	<6.15	28520 / 14762	143.30	276.90
		Tall Grass	28,205	<2.8	13071/ 6766	65.70	126.90
		Broadleaf plant/Insect	34,615	<3.53	16042/ 8304	80.60	156.80
		Seeds	13,846	<0.38	1782/ 923	9.00	17.30
Ornamentals, ground	100.0 / 46.3 (1)	Short grass	24,000	<2.40	11112 / 6781	65.80	107.88
		Tall grass	11,000	<1.10	5093 / 3108	30.20	49.45
		Broadleaf plant/Insect	13,500	<1.35	6251 / 3814	37.00	60.68
		Seeds	1,500	<0.15	695 / 424	4.10	6.74
Ornamentals, ground	100.0 / 46.3 (3)	Short grass	63,082	<6.31	29,207/	182.33	283.56

TABLE 6. Avian Acute and Chronic Risk Quotients Estimated from the Environmental Fate Model for Application of Non-granular Products Based on a Mallard Duck LC50 of > 10,000 ppm, a Mallard Duck NOAEC of 103 ppm, a TM and MBC half-life assumed to be 35 days

Crop/App. Method	TM /MBC Application Rate in lbs AI/acre/ (Annual Frequency of applications)	Food Items	Peak TM EEC (ppm)	Acute TM RQ (Peak TM EEC / LC50)	Peak / 56-day average MBC EEC (ppm)	Chronic MBC RQ (56-day average MBC EEC / NOAEC)	Chronic MBC RQ (Peak MBC EEC / NOAEC)
Onions, broadcast	11.2 / 5.2 (1)	Short grass	2,688	<0.27	1248 / 762	7.39	12.12
		Tall Grass	1,232	<0.12	572 / 349	3.39	5.55
		Broadleaf plant/Insect	1,512	<0.15	702 / 428	4.16	6.82
		Seeds	168	<0.02	78.0 / 47.6	0.46	0.76

ESTIMATES OF RISKS TO MAMMALS

Estimating the potential for adverse effects to wild mammals is based upon a 1995 draft version of guidance for mammalian risk assessments and methods used by Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994). The concentration of Thiophanate-methyl in the diet that is expected to be acutely lethal to 50% of the test population (LC50) is determined by dividing the LD50 value (usually a rat LD50) by the fraction of body weight consumed. A risk quotient is then determined by dividing the EEC by the derived LC50 value. Risk quotients are calculated for three separate weight classes of mammals (15, 35, and 1000 g), each presumed to consume four different kinds of food (short grass, tall grass, broadleaf plants/insects, and seeds).

Tables 7, 8, and 9 present estimated peak TM EECs, peak and 56-day average MBC EECs, acute TM EECs, and peak MBC chronic and 56-day average MBC chronic risk quotients for mammals by type of forage for each crop examined in this risk assessment. Table 7 presents such data for 15-gram mammals, Table 8 for 35-gram mammals, and Table 9 for 1000-gram mammals. The acute risk quotients are based on the assumption that the mammal species tested, the laboratory rat, is representative of all mammals and that the LD50 value determined for the rat is applicable to all mammalian species. **It must be noted that the LD50 value for TM determined for the rat was greater than 5,000, a level considered practically non-toxic to mammals. For the purpose of estimating acute risk quotients, the LC50 value for TM was assumed to be 5,000 ppm. Consequently, the resulting acute risk quotients are maximum estimates.**

Estimated Risk Quotients for 15-gram Mammals

Refer to Table 7 for estimates of EECs and acute and chronic RQ values for 15-gram mammals. The following generalities regarding exceedance of acute and chronic levels of concern (LOCs) are observed for 15-gram mammals. Refer to Table 7 for more specific details about LOC exceedances based on specific crops (i.e., short grass, tall grass, broadleaf plants/insects, and seeds) eaten by mammals.

The acute endangered species level of concern (LOC) based on an RQ of 0.1 was estimated to be exceeded for a 15-gram mammal when TM is applied at the maximum application rates listed on the product label under the following circumstances:

- one and twelve annual aerial applications to peaches;
- six annual aerial applications to turf;

- one and three annual ground application to ornamentals; and
- one annual ground application to onions

In addition, the acute restricted use LOC based on an RQ of 0.2 was estimated to be exceeded when TM is applied at the maximum annual application rates listed on the product label under the following circumstances:

- twelve annual aerial applications to peaches
- six annual aerial applications to turf;
- three annual ground applications to ornamentals;
- one annual ground application to ornamentals; and
- one annual ground application to onions

Furthermore, the acute LOC based on an RQ of 0.5 was estimated to be exceeded when TM is applied at the maximum annual application rates listed on the product label under the following circumstances:

- six annual aerial applications to turf;
- three annual ground applications to ornamentals;
- one annual ground application to ornamentals; and
- one annual ground application to onions

Chronic risk quotients based on peak MBC EECs estimated from the Environmental Fate model are estimated to exceed the Chronic LOC for 15-gram mammals based on an RQ of 1.0 when TM is applied at the maximum annual application rates listed on the product label under the following circumstances:

- One and twelve annual aerial applications to peaches
- Six annual aerial applications to turf;
- Three annual ground applications to ornamentals; and
- One annual ground application to onions.

Chronic risk quotients based on 56-day average MBC EECs are generally half the chronic RQ values based on risk quotients estimated from peak EECs. Consequently, the Chronic LOC values for 15-gram mammals based on 56-day average EECs are exceeded under all circumstances in which they are estimated to be exceeded when peak EECs are used to estimate chronic RQ values.

TABLE 7. Mammalian Acute and Chronic Risk Quotients for a 15-gram Mammal Estimated from the Environmental Fate Model for Application of Non-granular Products Based on a Rat LD50 of > 5000 mg/kg, a Rat NOAEL of 195 ppm, a TM and MBC half-life assumed to be 35 days (see TABLE 6 for EEC values)

Crop/App. Method	TM /MBC Application Rate in lbs AI/acre/ (Annual Frequency of applications)	Food Items	Acute TM RQ [(Peak TM EEC * fraction body wt. Ingested daily) / LD50)]	Chronic MBC RQ (56-day average MBC EEC / NOAEL)	Chronic MBC RQ (Peak MBC EEC / NOAEL)
Peaches / aerial	1.60 / 0.74 (1)	Short grass	< 0.07	0.53	0.87
		Tall grass	< 0.03	-	--
		Broadleaf plant/Insect	< 0.04	-.	-
		Seeds	< 0.01	-	-
Peaches / aerial	1.60 / 0.74 (12)	Short grass	< 0.37	2.00	4.40
		Tall grass	< 0.17	0.90	2.10
		Broadleaf plant/Insect	< 0.21	1.10	2.50
		Seeds	< 0.02	0.12	0.27
Soybean / aerial	1.05 / 0.49 (2)	Short grass	< 0.05	0.04	0.06
		Tall grass	< 0.02	-	-
		Broadleaf plant/Insect	< 0.03	-	-
		Seeds	< 0.01	-	-
Turf / ground	76.6 / 35.5 (6)	Short grass	< 11.69	71.90	138.94
		Tall Grass	< 5.36	33.00	63.68
		Broadleaf plant/Insect	< 6.58	40.50	78.15
		Seeds	<0.373	4.50	8.68
Ornamentals, ground	100.0 / 46.3 (1)	Short grass	<4.56	33.04	54.14
		Tall grass	<2.09	15.14	24.81
		Broadleaf plant/Insect	<2.57	18.58	30.45
		Seeds	<0.29	2.06	3.38
Ornamentals, ground	100.0 / 46.3 (3)	Short grass	<11.99	91.49	142.29
		Tall grass	<5.49	41.93	65.22
		Broadleaf plant/Insect	<6.74	51.46	80.04
		Seeds	<0.75	5.72	8.89
Onions, broadcast	11.2 / 5.2 (1)	Short grass	<0.51	3.71	6.08
		Tall Grass	<0.23	1.70	Mg/kg
		Broadleaf plant/Insect	<0.29	2.09	3.42
		Seeds	<0.03	0.23	0.38

NOTE: Estimated Acute and Chronic RQ values assume 0.95 of body weight consumed for a 15-gram mammal

Estimated Risk Quotients for 35-gram Mammals

Refer to Table 8 for estimates of EECs and acute and chronic RQ values for 35-gram mammals. The following generalities regarding exceedance of acute and chronic levels of concern (LOCs) are observed for 35-gram mammals. Refer to Table 8 for more specific details about LOC exceedances based on specific crops (i.e., short grass, tall grass, broadleaf plants/insects, and seeds) eaten by mammals.

The acute endangered species level of concern (LOC) based on an RQ of 0.1 was estimated to be exceeded for a 35-gram mammal when TM is applied at the maximum application rates listed on the product label under the following circumstances:

- one and twelve annual aerial applications to peaches;
- six annual aerial applications to turf;
- one and three annual ground applications to ornamentals; and
- one annual ground application to onions.

In addition, the acute restricted use LOC based on an RQ of 0.2 was estimated to be exceeded when TM is applied at the maximum annual application rates listed on the product label under the following circumstances:

- twelve annual aerial applications to peaches;
- six annual aerial applications to turf;
- one and three annual ground applications to ornamentals; and
- one annual ground application to onions.

Furthermore, the acute LOC based on an RQ of 0.5 was estimated to be exceeded when TM is applied at the maximum annual application rates listed on the product label under the following circumstances:

- six annual aerial applications to turf; and
- one and three annual ground applications to ornamentals.

Chronic risk quotients based on peak MBC EECs estimated from the Environmental Fate model are estimated to exceed the Chronic LOC for 35-gram mammals based on an RQ of 1.0 when TM is applied at the maximum annual application rates listed on the product label under the following circumstances:

- Twelve annual aerial applications to peaches;
- six annual aerial applications to turf;
- Three annual ground applications to ornamentals; and

- One annual ground application to onions.

Chronic risk quotients based on 56-day average MBC EECs are roughly half the chronic RQ values based on risk quotients estimated from peak EECs. Consequently, the Chronic LOC values for 35-gram mammals based on 56-day average EECs are exceeded under all circumstances in which they are estimated to be exceeded when peak EECs are used to estimate chronic RQ values.

TABLE 8. Mammalian Acute and Chronic Risk Quotients for a 35-gram Mammal Estimated from the Environmental Fate Model for Application of Non-granular Products Based on a Rat LD50 of > 5000 mg/kg, a Rat NOAEL of 195 ppm, a TM and MBC half-life assumed to be 35 days (see TABLE 6 for EEC values)

Crop/App. Method	TM /MBC Application Rate in lbs AI/acre/ (Annual Frequency of applications)	Food Items	Acute TM RQ [(Peak TM EEC * fraction body wt. Ingested / LD50)]	Chronic MBC RQ (56-day average MBC EEC / NOAEL)	Chronic MBC RQ (Peak MBC EEC / NOAEL)
Peaches / aerial	1.60 / 0.74 (1)	Short grass	< 0.05	0.04	0.60
		Tall grass	< 0.01	-	-
		Broadleaf plant/Insect	< 0.02	-	-
		Seeds	< 0.01	-	-
Peaches / aerial	1.60 / 0.74 (12)	Short grass	< 0.26	1.40	2.39
		Tall grass	< 0.12	0.60	1.10
		Broadleaf plant/Insect	< 0.14	0.80	1.34
		Seeds	< 0.02	0.01	0.19
Soybean / aerial	1.05 / 0.49 (1)	Short grass	< 0.03	0.03	0.04
		Tall grass	< 0.02	-	-
		Broadleaf plant/Insect	< 0.02	-	-
		Seeds	< 0.01	-	-
Turf / ground	76.6 / 35.5 (6)	Short grass	< 8.12	50.00	96.53
		Tall Grass	< 3.72	22.90	44.24
		Broadleaf plant/Insect	< 4.57	28.10	54.30
		Seeds	< 0.51	3.10	6.03
Ornamentals, ground	100.0 / 46.3 (1)	Short grass	< 3.17	22.95	37.61
		Tall grass	< 1.45	10.52	17.24
		Broadleaf plant/Insect	< 1.78	12.91	21.16
		Seeds	< 0.20	1.43	2.35
Ornamentals, ground	100.0 / 46.3 (3)	Short grass	< 8.33	63.56	98.85
		Tall grass	< 3.82	29.13	45.31

TABLE 8. Mammalian Acute and Chronic Risk Quotients for a 35-gram Mammal Estimated from the Environmental Fate Model for Application of Non-granular Products Based on a Rat LD50 of > 5000 mg/kg, a Rat NOAEL of 195 ppm, a TM and MBC half-life assumed to be 35 days (see TABLE 6 for EEC values)

Crop/App. Method	TM /MBC Application Rate in lbs AI/acre/ (Annual Frequency of applications)	Food Items	Acute TM RQ [(Peak TM EEC * fraction body wt. Ingested / LD50)]	Chronic MBC RQ (56-day average MBC EEC / NOAEL)	Chronic MBC RQ (Peak MBC EEC / NOAEL)
		Broadleaf plant/Insect	< 4.68	35.75	55.61
		Seeds	< 0.52	3.97	6.18
Onions, broadcast	12 / 5.6 (1)	Short grass	< 0.35	2.58	4.22
		Tall Grass	< 0.16	1.18	1.94
		Broadleaf plant/Insect	< 0.20	1.45	2.38
		Seeds	< 0.02	0.16	0.26

NOTE: Estimated Acute and Chronic RQ values assume 0.66 of body weight consumed for a 35-gram mammal

Estimated Risk Quotients for 1000-gram Mammals

Refer to Table 9 for estimates of EECs and acute and chronic RQ values for 1000-gram mammals. The following generalities regarding exceedance of acute and chronic levels of concern (LOCs) are observed for 1000-gram mammals. Refer to Table 9 for more specific details about LOC exceedances based on specific crops (i.e., short grass, tall grass, broadleaf plants/insects, and seeds) eaten by mammals.

The acute endangered species level of concern (LOC) based on an RQ of 0.1 was estimated to be exceeded for a 1000-gram mammal when TM is applied at the maximum application rates listed on the product label under the following circumstances:

- twelve annual aerial applications to peaches;
- six annual aerial applications to turf; and
- one and three annual ground applications to ornamentals.

In addition, the acute restricted use LOC based on an RQ of 0.2 was estimated to be exceeded when TM is applied at the maximum annual application rates listed on the product label under the following circumstances:

- six annual aerial applications to turf; and
- one and three annual ground applications to ornamentals.

Furthermore, the acute LOC based on an RQ of 0.5 was estimated to be exceeded when TM is applied at the maximum annual application rates listed on the product label under the following

circumstances:

- six annual aerial applications to turf; and
- one and three annual ground applications to ornamentals.

Chronic risk quotients based on peak MBC EECs estimated from the Environmental Fate model are estimated to exceed the Chronic LOC for 1000-gram mammals based on an RQ of 1.0 when TM is applied at the maximum annual application rates listed on the product label under the following circumstances:

- six annual aerial applications to turf; and
- one and three annual ground applications to ornamentals.

Chronic risk quotients based on 56-day average MBC EECs are roughly half the chronic RQ values based on risk quotients estimated from peak EECs. Consequently, the Chronic LOC values for 1000-gram mammals based on 56-day average EECs are exceeded under all circumstances in which they are estimated to be exceeded when peak EECs are used to estimate chronic RQ values.

TABLE 9. Mammalian Acute and Chronic Risk Quotients for a 1000-gram Mammal Estimated from the Environmental Fate Model for Application of Non-granular Products Based on a Rat LD50 of > 5000 mg/kg, Rat NOAEL of 195 ppm, TM and MBC half-life assumed to be 35 days (see Table 6 for EEC values)

Crop/App. Method	TM /MBC Application Rate in lbs AI/acre/ (Annual Frequency of applications)	Food Items	Acute TM RQ [(Peak TM EEC * fraction of body wt. Ingested/ LD50)]	Chronic MBC RQ (56-day average MBC EEC / NOAEL)	Chronic MBC RQ (Peak MBC EEC / NOAEL)
Peaches / aerial	1.60 / 0.74 (1)	Short grass	< 0.01	< 1	< 1
		Tall grass	< 0.01	-	-
		Broadleaf plant/Insect	< 0.01	-	-
		Seeds	< 0.01	-	-
Peaches / aerial	1.60 / 0.74 (12)	Short grass	< 0.06	< 1	< 1
		Tall grass	< 0.03	-	-
		Broadleaf plant/Insect	< 0.03	-	-
		Seeds	< 0.01	-	-
Soybean / aerial	1.05 / 0.49 (1)	Short grass	< 0.01	< 1	< 1
		Tall grass	< 0.01	-	-

TABLE 9. Mammalian Acute and Chronic Risk Quotients for a 1000-gram Mammal Estimated from the Environmental Fate Model for Application of Non-granular Products Based on a Rat LD50 of > 5000 mg/kg, Rat NOAEL of 195 ppm, TM and MBC half-life assumed to be 35 days (see Table 6 for EEC values)

Crop/App. Method	TM /MBC Application Rate in lbs AI/acre/ (Annual Frequency of applications)	Food Items	Acute TM RQ [(Peak TM EEC * fraction of body wt. Ingested/ LD50)]	Chronic MBC RQ (56-day average MBC EEC / NOAEL)	Chronic MBC RQ (Peak MBC EEC / NOAEL)
		Broadleaf plant/Insect	< 0.01	-	-
		Seeds	< 0.01	-	-
Turf / ground	76.6 / 35.5 (6)	Short grass	< 1.85	11.40	21.94
		Tall Grass	< 0.85	5.20	10.94
		Broadleaf plant/Insect	< 1.04	6.40	12.34
		Seeds	< 0.12	0.70	1.37
Ornamentals, ground	100.0 / 46.3 (1)	Short grass	< 0.72	5.22	8.55
		Tall grass	< 0.33	2.39	3.92
		Broadleaf plant/Insect	< 0.41	2.93	4.81
		Seeds	< 0.05	0.33	0.53
Ornamentals, ground	100.0 / 46.3 (3)	Short grass	< 1.87	14.44	22.47
		Tall grass	< 0.86	6.62	10.30
		Broadleaf plant/Insect	< 1.05	8.13	12.64
		Seeds	< 0.12	0.90	1.40
Onions, broadcast	11.2 / 5.2 (1)	Short grass	< 0.08	0.59	0.96
		Tall Grass	< 0.04	-	-
		Broadleaf plant/Insect	< 0.05	-	-
		Seeds	< 0.01	-	-

NOTE: Estimated Acute and Chronic RQ values assume 0.15 of body weight consumed for a 1000-gram mammal

QUALITATIVE ASSESSMENT OF RISKS TO TERRESTRIAL INVERTEBRATES, INSECTS, AND TERRESTRIAL PLANTS

Based on information in the literature, the primary degradate of TM, MBC is very highly toxic

to earthworms on an acute basis; and has inhibited earthworm reproduction and growth in acute and chronic laboratory tests from foliar residues. Build up of MBC residues in apple orchard soils from repeated TM applications may potentially inhibit growth and reproduction of earthworms in the top soil horizon (WHO, 1993).

Risks to non-target insects were not assessed. Results of acceptable studies are used for recommending appropriate label precautions.

Tier I (122-1) terrestrial plant toxicity tests indicate low potential for toxicity to 7 of the 10 crop plants tested in seedling emergence and vegetative vigor tests at up to 1.4 lbs. ai per acre. The maximum single label dosage allowed on TM labels is 100 lbs. ai per acre, therefore, additional tests are needed at the higher label dosage. Tier II (123-1) dose response tests for the most sensitive plants onion, soybean, and cucumber must be repeated due to poor germination or other insufficiencies of the test.

AQUATIC RISK ASSESSMENT

EECs used to determine acute and chronic risks to aquatic organisms were estimated from GENEEC and PRZM/EXAMS. EECs from GENEEC were used for turf and ornamental scenarios since inadequate input data were available to run these scenarios with PRZM/EXAMS. A complete discussion of these models and the associated input parameters for each scenario is presented in the Water Resources section of this EFED Science Chapter.

Based on environmental fate data on hydrolysis of TM, conversion of TM to MBC in the aquatic environment increases as pH increases. At pH 5, TM is stable to hydrolysis. At pH 7, the hydrolytic half-life of TM is 36 days. At pH 9, the hydrolytic half-life of TM is 0.7 days. Because the acute aquatic toxicity studies were performed at pH values ranging from 6.5 to 8.3 and the duration of the studies ranges from 48 to 96 hours, it is assumed that relatively little conversion of TM to MBC occurred and that fish and invertebrates are, therefore, exposed to TM during the course of the acute toxicity studies. Because chronic aquatic toxicity studies were performed at pH values ranging from 7.2 to 8.0 and at durations ranging from 21 to 56 days, it is assumed that fish and invertebrates are exposed primarily to MBC during the course of these chronic studies.

Acute risk quotients were estimated based on LC50s and peak EEC values. Chronic risk quotients were estimated from NOAELs, 21-day average EECs for invertebrates, and 56-day average EECs for fish

ESTIMATES OF RISKS TO FRESHWATER FISH

Estimates of acute and chronic risk quotients for freshwater fish are presented in Table 10. Acute endangered species levels of concern based on a risk quotient of 0.05 and acute restricted use levels of concern based on a risk quotient of 0.1 were exceeded under the following circumstances:

- six annual ground applications to turf; and
- three annual ground applications to ornamentals.

No acute high risk levels of concern based on a risk quotient of 0.5 were exceeded. Chronic levels of concern based on a risk quotient of 1.0 were exceeded for all crops and locations modeled.

TABLE10. Acute and Chronic Risk Quotients Estimated for Freshwater Fish from Application of TM Based on a Rainbow Trout LC50 of 8.3 ppm for TM and a Channel Catfish NOAEC of 0.002 ppm for MBC

Crop / Application Method	TM / MBC Application Rate in pounds AI per acre (Annual Frequency of applications)	Acute TM EEC (ppm)	Acute TM RQ (TM EEC/ LC50)	Chronic MBC EEC (ppm)	Chronic MBC RQ (60-day average MBC EEC / NOAEC)
Peaches / aerial PRZM/EXAMS	1.60 / 0.74 (12)	0.036	0.004	0.14	70
Soybean / aerial PRZM/EXAMS	1.05 / 0.49 (2)	0.006	0.001	0.021	11
Turf / ground GENEEC	76.6 / 35.5 (6)	2.13	0.26	0.73	365
Ornamentals/ ground GENEEC	100.0 / 46.3 (3)	2.7	0.33	0.61	305
Onions, broadcast PRZM/EXAMS	11.2 / 5.60 (1)	0.006	0.001	0.2	100

LOC's

CROP	**ACUTE HIGH RISK EXCEEDED (Y/N)**	**ACUTE RESTRICTED USE EXCEEDED (Y/N)**	**ENDANGERED SPECIES CONCERN EXCEEDED (Y/N)**	**CHRONIC RISK EXCEEDED (Y/N)**
PEACHES	N	N	N	Y
SOYBEAN	N	N	N	Y
TURF	N	Y	Y	Y
ONION	N	N	N	Y
ORNAMENTALS	N	Y	Y	Y

ESTIMATES OF RISKS TO FRESHWATER INVERTEBRATES

Estimates of acute and chronic risk quotients for freshwater invertebrates are presented in Table 11. Acute endangered species levels of concern based on a risk quotient of 0.05 and acute restricted use levels of concern based on a risk quotient of 0.1 were exceeded under the following circumstances:

- six annual ground applications to turf; and
- three annual ground applications to ornamentals.

Acute high risk levels of concern based on a risk quotient of 0.5 were exceeded for three annual ground applications to ornamentals. Chronic levels of concern based on a risk quotient of 1.0 were exceeded for all crops and locations modeled.

TABLE 11. Estimated Acute and Chronic Risk Quotients for Freshwater Invertebrates from Application of TM Based on a Daphnia magna LC50 of 5.4 ppm for TM and a NOAEC of 0.003 ppm for MBC

Crop/App. Method	TM / MBC Application Rate in pounds AI per acre (Annual Frequency of applications)	Acute TM EEC (ppm)	Acute TM RQ (Peak TM EEC / LC50)	21-day average MBC EEC (ppm)	Chronic MBC RQ (21-day average MBC EEC / NOAEC)
Peaches / aerial PRZM/EXAMS	1.60 / 0.74 (12)	0.036	0.007	0.144	48
Soybean / aerial PRZM/EXAMS	1.05 / 0.49 (2)	0.006	0.001	0.022	7
Turf / ground GENEEC	76.6/35.5 (6)	2.13	0.39	1.12	**373**
Ornamentals, ground GENEEC	100.0 / 46.3 (3)	2.7	0.5	0.95	**317**
Onions, broadcast PRZM/EXAMS	11.2 / 5.60 (1)	0.006	0.001	0.222	**74**

LOC's

CROP	**ACUTE HIGH RISK EXCEEDED (Y/N)**	**ACUTE RESTRICTED USE EXCEEDED (Y/N)**	**ENDANGERED SPECIES CONCERN EXCEEDED (Y/N)**	**CHRONIC RISK EXCEEDED (Y/N)**
PEACHES	N	N	N	Y
SOYBEAN	N	N	N	Y
TURF	N	Y	Y	Y
ONION	N	N	N	Y
ORNAMENTALS	Y	Y	Y	Y

ESTIMATES OF RISKS TO ESTUARINE AND MARINE FISH

Estimates of acute and chronic risk quotients for estuarine and marine fish are presented in Table 12. Acute endangered species levels of concern based on a risk quotient of 0.05 and acute restricted use levels of concern based on a risk quotient of 0.1 were exceeded under the following circumstances:

- six annual ground applications to turf; and
- three annual ground applications to ornamentals.

No acute high risk levels of concern based on a risk quotient of 0.5 were exceeded. Chronic levels of concern based on a risk quotient of 1.0 were exceeded for all crops and locations modeled.

Endpoints from a freshwater fish chronic toxicity test on channel catfish were used in this

assessment based on the assumption that the channel catfish and sheepshead minnow, the species typically used for tests of chronic toxicity to marine and estuarine organisms, have the same sensitivity to TM. A chronic sheepshead minnow study can be performed to rebut this assumption.

TABLE12. Acute and Chronic Risk Quotients Estimated for Estuarine and Marine Fish from Application of TM Based on a Sheepshead Minnow LC50 of 17 ppm for TM and a Channel Catfish NOAEC of 0.002 ppm for MBC

Crop / Application Method	TM / MBC Application Rate in pounds AI per acre (Annual Frequency of applications)	Peak TM EEC (ppm)	Acute TM RQ (TM EEC/ LC50)	60-day average MBC EEC (ppm)	Chronic MBC RQ (60-day average MBC EEC / NOAEC)
Peaches/Aerial PRZM/EXAMS	1.60/ 074 (12)	0.036	0.002	0.139	70
Soybean / aerial PRZM/EXAMS	1.05 / 0.49 (2)	0.006	0.0004	0.021	11
Turf / ground GENEEC	76.6 / 35.5 (6)	2.13	0.125	0.73	365
Ornamentals/ ground GENEEC	100.0 / 46.3 (3)	2.7	0.159	0.61	305
Onions, broadcast PRZM/EXAMS	11.2 / 5.60 (1)	0.006	0.0004	0.2	100

LOC's

CROP	**ACUTE HIGH RISK EXCEEDED (Y/N)**	**ACUTE RESTRICTED USE EXCEEDED (Y/N)**	**ENDANGERED SPECIES CONCERN EXCEEDED (Y/N)**	**CHRONIC RISK EXCEEDED (Y/N)**
PEACHES	N	N	N	Y
SOYBEAN	N	N	N	Y
TURF	N	Y	Y	Y
ONION	N	N	N	Y
ORNAMENTALS	N	Y	Y	Y

ESTIMATES OF RISKS TO ESTUARINE AND MARINE INVERTEBRATES

Estimates of acute and chronic risk quotients for estuarine and marine invertebrates are presented in Table 13. Acute endangered species levels of concern based on a risk quotient of 0.05 and acute restricted use levels of concern based on a risk quotient of 0.1 were exceeded under the following circumstances:

- six ground applications to turf; and
- three annual ground applications to ornamentals.

Acute high risk levels of concern based on a risk quotient of 0.5 were also exceeded for each of these circumstances. Chronic levels of concern based on a risk quotient of 1.0 were exceeded under the following circumstances:

- twelve annual aerial applications to peaches;
- six annual ground applications to turf;
- three annual ground applications to ornamentals; and
- one annual ground application to onions.

TABLE 13. Estimated Acute and Chronic Risk Quotients for Marine/Estuarine Invertebrates from Application of TM Based on a Mysid shrimp LC50 of 1.1 ppm for TM and a NOAEC of 0.025 ppm for MBC

Crop/App. Method	TM / MBC Application Rate in pounds AI per acre (Annual Frequency of applications)	Peak TM EEC (ppm)	Acute TM RQ (TM EEC / LC50)	21-day average MBC EEC (ppm)	Chronic MBC RQ (21-day average MBC EEC / NOAEC)
Peaches/aerial PRZM/EXAMS	1.60 / 0.74 (12)	0.036	0.033	0.154	6
Soybean / aerial PRZM/EXAMS	1.05 / 0.49 (2)	0.006	0.006	0.022	0.9
Turf / ground GENEEC	76.6 / 35.5 (6)	2.13	1.94	1.12	45
Ornamentals, ground GENEEC	100.0 / 46.3 (3)	2.7	2.46	0.95	38
Onions, broadcast PRZM/EXAMS	11.2 / 5.60 (1)	0.006	0.006	0.222	**9**

LOC's

CROP	**ACUTE HIGH RISK EXCEEDED (Y/N)**	**ACUTE RESTRICTED USE EXCEEDED (Y/N)**	**ENDANGERED SPECIES CONCERN EXCEEDED (Y/N)**	**CHRONIC RISK EXCEEDED (Y/N)**
PEACHES	N	N	N	Y
SOYBEAN	N	N	N	Y
TURF	Y	Y	Y	Y
ONION	N	N	N	Y
ORNAMENTALS	Y	Y	Y	Y

ESTIMATES OF RISKS TO AQUATIC PLANTS

Tier I (122-1) terrestrial plant toxicity tests indicate low potential for toxicity to 7 of the 10 crop plants tested in seedling emergence and vegetative vigor tests at up to 1.4 lbs. ai per acre. The maximum single label dosage allowed on TM labels is 100 lbs. ai per acre, therefore, additional tests are needed at the higher label dosage. Tier II (123-1) dose response tests for the most sensitive plants onion, soybean, and cucumber must be repeated due to poor germination or other insufficiencies of the test. A nontarget plant terrestrial risk assessment cannot be conducted for TM at this time.

Aquatic plant toxicity dose response data (123-2) were available for all five aquatic plant species. Of the five aquatic plant species evaluated, the freshwater diatom, *Navicula Pelliculosa,* was determined to be the most sensitive. Exposure to non-target aquatic plants may occur through runoff or spray drift from adjacent treated sites. An aquatic plant risk assessment for acute high risk and acute endangered species risk is conducted with endpoints from the most sensitive aquatic plant. To date there are no known non-vascular plant species on the endangered species list. Surface water concentrations from runoff and spray drift are estimated using the GENEEC model for turf and ornamentals and the PRZM/EXAMS model for and onions. The acute risk quotient for non-target plants is determined by dividing the peak concentration of TM in surface water by the EC50 value for the most sensitive aquatic plant species. The acute endangered species risk quotient is determined by dividing the peak concentration of TM in surface water by the NOAEC determined for endangered plants.

TABLE 13. Estimated Acute Risk Quotients for Aquatic Plants Exposed to TM Based upon the Freshwater Diatom, *Navicula pelliculosa* EC_{50} of 0.93 ppm and a NOAEC of 0.43 ppm for Endangered Species

Crop (Type of Application) - Frequency of Application (Application Rate in pounds ai per acre)	TM EEC (ppb)	Non-target Plant RQ (EEC / EC_{50})	Endangered Species RQ (EEC / NOAEC)
Ornamentals (ground) - 3 (100)	2460	2.65	5.72
Turf (ground) - 6 (76.6)	2130	2.29	4.95
Peaches (aerial) - 12 (1.6)	36	0.04	0.08
Onions (ground) - 1 (11.2)	6.25	0.01	0.01

The freshwater diatom (*Navicula pelliculosa*) was the most sensitive aquatic plant species. The acute high risk LOC and the acute endangered species LOC based on a risk quotient of 1.0 is exceeded for turf and ornamentals. Methods are not currently available to assess chronic risks to aquatic plants.

ENDANGERED SPECIES RISK ASSESSMENT

Specific information on exceedances of acute endangered species LOC values is provided in the terrestrial and aquatic risk assessment sections of this EFED science chapter on TM.

The Endangered Species Protection Program is expected to become final in the future. Limitations in the use of thiophanate methyl may be required to protect endangered and threatened species, but these limitations have not been defined and may be formulation specific. EPA anticipates that a consultation with the Fish and Wildlife Service may be conducted in accordance with the species based priority described in the ESP Program. After completion of consultation, registrants will be informed if any required label modifications are necessary. Such modifications would most likely consist of generic label statement referring pesticide users to use limitations contained in county bulletins.

RISK CHARACTERIZATION

The rapid rate of degradation of thiophanate-methyl (TM) to the primary degradate, methyl 2-benzimidazolylcarbamate (MBC), on foliage and in water and the persistence of MBC on foliage and in water strongly influences the estimates of acute and chronic risks to ecological organisms and exposure to humans from ingestion of drinking water.

For the purpose of this risk assessment, rapid transformation of TM to MBC in water was assumed based on environmental fate data regarding hydrolysis and photolysis of TM in the aquatic environment under ambient conditions. Transformation of TM to MBC will be particularly rapid near the surface of the water column where photolysis will have a strong influence with a half-life on the order of about one-half to two days depending on the season and latitudinal distance from the equator. Transformation of TM to MBC will also be particularly rapid for aquatic environments with a pH value of 9, with a half-life of less than one day. As aquatic pH decreases, the transformation of TM to MBC is slower, with an estimated half-life of 36 days at pH 7. Evidence from environmental fate studies indicates that MBC is very stable to hydrolysis and photolysis and is, therefore, persistent in the aquatic environment. To simplify quantitative estimates of risks to aquatic organisms, it was assumed that acute exposure and associated risks are exclusively to TM and that chronic exposures and associated risks are exclusively to MBC. In reality, at least some TM and MBC is probably present throughout the periods of exposure from initial pesticide application up to the 60-day period that is generally used to assess ecological risks and up to the 60- to 90-day period used to assess exposure from ingestion of drinking water. To account for concentrations of both TM and MBC throughout the period of exposure, formation and decline curves would have to be generated. Inadequate data were available, however, to develop formation and decline curves for TM and MBC.

An Environmental Fate model was used to estimate exposures and risks to birds and mammals. This model assumes first-order decay in estimating the concentration of chemical at each day after initial application based on the concentration resulting from initial and subsequent applications of pesticide. The foliar dissipation half-life is a key input parameter to the Environmental Fate model. Limited dislodgeable foliar residue (DFR) data were available to determine the foliar dissipation half-life of TM and no data were available to determine the foliar dissipation half-life of MBC. A foliar dissipation half-life of 31.4 days was determined for TM based on measured residues on apples in Washington state. This half-life was assumed for all crops and locations examined in this risk assessment. A foliar dissipation half-life of 3.8 days, however, was determined for TM from plant residue data for apples in New York. The apple orchard in the town of Quincy, WA, located east of the Cascades mountain range, is characterized by dry climate and low precipitation, whereas the apple orchard in New York is characterized by wet climate and high precipitation. Thus, increased wash-off may have contributed to the more rapid dissipation of TM observed in New York. .

There are many uncertainties associated with foliar dissipation half-life values developed based on the DFR study on apples. The half-life estimates provided from the DFR study on apples were based on two applications of one pound of TM per acre at 7-day intervals. This is less than half the recommended label dosage for apples in the southeastern United States and far less than the maximum number of twelve applications per year used in this risk assessment. The TM label includes no upper

limit on the annual frequency of applications to apples and repeat application is suggested at 7-day intervals. In addition, this study failed to comply with several aspects of the OPPTS 875 guidelines. For example, these guidelines require that DFR data be collected from three geographical locations, but data were only collected from two geographical locations. As an additional example, the Iwata approach for sampling from tree crops is recommended by EPA, but there was no reference to this approach in the study. Finally, several deviations from sampling and analytical protocols were reported, thereby leading to questions regarding the accuracy of study results.

A dislodgeable foliar residue study was also performed on strawberries, but residue levels of TM and MBC were not distinguished. TM applied to strawberries in North Carolina dissipated with a half-life of 1.08 days for combined TM and MBC residues, whereas TM applied to strawberries in the Central Valley of California dissipated with a half-life of 1.78 days for combined TM and MBC residues.

Given the uncertainties associated with the DFR study on apples, a foliar dissipation half-lie of 35 days was assumed in estimating acute risks to birds and mammals from exposure to TM applied to all crops examined in this risk assessment. In the absence of DFR data for MBC, a default half-life of 35 days was assumed for MBC based on maximum foliar dissipation half-lives of the most persistent pesticides for which such data are available. For crops, locations, and times of the year with increased wash-off and/or potential for photodegradation, potential for exposure would be less than that predicted based on a foliar dissipation half-life of 31.4 days. The converse is also true. For example, apples would be expected to have longer foliar dissipation half-lives than strawberries since leaf surfaces in the upper portion of trees can inhibit light penetration to the leaf surfaces lower on the tree thereby reducing the potential for photodegradation. In addition, foliar dissipation half-lives at locations with higher precipitation and more sunlight would be expected to be shorter than at locations with lower precipitation and sunlight. DFR data for TM and MBC for additional crops, locations, and time periods during the growing season would reduce uncertainty associated with foliar dissipation half-lives assumed for TM and MBC for crops examined in this risk assessment.

There is high uncertainty associated with estimates of acute risks to birds and mammals. TM is practically nontoxic to birds and mammals on an acute exposure basis. The concentrations at which acute effects are observed for birds and mammals is unknown, but is greater than 10,000 ppm for birds and 5,000 ppm for mammals. Effects data on surrogate birds and mammals indicate that chronic effects are of far greater concern than acute effects, with concentrations at which chronic effects were exhibited being several orders of magnitude lower than the TM concentrations observed to exhibit no acute effects. Risk quotients estimated to quantify acute risks from exposure to TM are bounding estimates and serve only as an estimate of the upper limit of acute risks.

Although TM is practically nontoxic to birds and mammals on an acute exposure basis, estimated chronic hazards and risks to birds and mammals based on exposure to MBC are quite high. Estimated chronic risks to birds that consume food items other than seeds (i.e., short grass, tall grass, broadleaf insects and plants) are particularly high for turf and ornamental uses at maximum annual application rates and frequencies, and somewhat lower for maximum application to peaches.

Estimated chronic risks to mammals that consume food items other than seeds are particularly high for TM applied to turf and ornamentals at the maximum annual application rates and frequencies listed on the TM label. For ornamentals, the estimated risks are high even with only one annual application at the maximum rate on the TM product label. The estimated chronic risks tend to be several-fold higher for small mammals (i.e., 15-gram and 35-gram body weight) than for large mammals (i.e., 1000-gram body weight).

Estimated acute risks to aquatic plants were exceeded based on application of TM to turf and ornamentals at the maximum application rate and frequency listed on the TM label. Methods are not currently available to assess chronic risks to aquatic plants. Inadequate information is available to assess acute and chronic risks to terrestrial plants.

Under most agricultural conditions, TM entering the aquatic environment is expected to convert rapidly to MBC. MBC is very persistent but is relatively immobile in sandy loam or silt loam soils, and is likely to remain in the upper soil profile of these and similar soils. However, MBC has potential to leach to groundwater in highly sandy soils with low organic matter.

No data on monitored concentrations of TM or MBC were found in surface water or ground water. Neither TM nor its primary degradate, MBC, are regulated under the Safe Drinking Water Act. As a result, neither Maximum Contaminant Levels (MCLs) nor drinking water health advisories (HAs) for these chemicals have been established by the EPA Office of Water. Data on levels of TM and MBC monitored following application of TM in the vicinity of and down-gradient of locations where TM is used would lead to higher confidence in concentrations of surface water and ground water. Data on removal efficiencies of TM and MBC at drinking water utilities downstream or down-gradient of locations at which TM is applied and/or monitored levels of TM and MBC in finished drinking water at these utilities would lead to much higher certainty in estimates of concentrations to which individuals ingesting drinking water from these locations would be exposed.

Given the relatively rapid formation of the primary degradate of TM, MBC, surface water concentrations of MBC were also estimated. The maximum amount of MBC formed from Thiophanate-methyl is approximately 82.7 percent of TM initially applied based on results from the aerobic soil metabolism study (MRID #106085). Therefore, a conservative application rate of MBC was estimated based on the product of (1) the application rate of TM; (2) the maximum conversion of TM to MBC (i.e., 0.827); and (3) the molecular weight ratio of TM to MBC for mass balance on molar bases (i.e., 0.56).

In the absence of monitoring data on TM and MBC in surface water, Estimated Environmental Concentrations (EECs) of TM and MBC in surface water are based on modeling. The Tier II PRZM/EXAMS model was used to estimate surface water concentrations from use of TM at maximum application rates and frequencies for peaches, beans, and onions. Each location modeled for peaches, beans, and onions was selected to represent the high end of exposures that could occur at any possible location in the United States for each of these crops. Surface water concentrations are expected to be lower than those modeled at locations that are less vulnerable to runoff and spray drift. The distribution of surface water concentrations that results from application of TM at locations throughout the United

States is not known.

Surface water concentrations of TM and MBC for turf and ornamentals were modeled using GENEEC rather then PRZM/EXAMS because standard values for input parameters for these crops have not been developed. The GENEEC model is unable to account for specific geographical and climatic characteristics for locations at which TM is applied to turf and ornamentals. Several factors may lead to lower EECs for TM and MBC from application of TM to turf and ornamentals. Some factors that may contribute to lower TM and MBC EECs include dilution as a result of increased precipitation, incorporation of pesticide by broadcast rather than aerial application, thereby leading to lower potential for spray drift, and the presence of soils that adsorb TM and MBC more strongly than indicated by the Koc value used in the GENEEC model. In addition, GENEEC models runoff and spray drift from a 10-hectare field immediately adjacent to 1-hectare pond that is 2 meters deep with no outlet. Factors such as a greater distance from source of pesticide application to a pond, larger pond size, and smaller area of application would lead to lower surface water concentrations than those estimated from the GENEEC model. On the other hand, GENEEC model estimates are based on a single application of pesticide. Therefore, higher EECs can be expected from the use of TM and MBC when multiple applications of TM are specified on the label. Furthermore, aquatic environments such as prairie potholes, drainage ditches, and bayous, and shallow cold water streams immediately adjacent to areas of application of TM are expected to have higher concentrations than those modeled in this risk assessment.

The GENEEC and PRZM/EXAMS models were used to determine Estimated Environmental Concentrations (EECs) in surface water. These EECs are used with data on acute and chronic toxicity endpoints to estimate acute and chronic risks to aquatic organisms. EECs from GENEEC were used for turf and ornamental scenarios since inadequate input data were available to run these scenarios with PRZM/EXAMS.

TM is slightly to moderately toxic to aquatic organisms on an acute exposure basis. Although no estimated acute risk levels of concern, based on a risk quotient of 0.5, were exceeded for freshwater fish and invertebrates (except for ornamentals)and estuarine and marine fish, estimated acute endangered species levels of concern, based on a risk quotient of 0.05, and acute restricted use levels of concern, based on a risk quotient of 0.1, were exceeded for six annual ground applications of TM to turf, and three annual ground applications of TM to ornamentals. For estuarine and marine invertebrates, estimated acute high risk levels of concern were exceeded for turf and ornamentals at the maximum application rate and frequency listed on the TM label. These estimates are based on the assumption that the surrogate species tested to derive the toxicity endpoint is representative of all species of that class.

Estimated chronic levels of concern, based on a risk quotient of 1.0, were exceeded for freshwater fish and invertebrates and estuarine and marine fish for all crops and locations modeled at the maximum application rate and frequency listed on the TM label. Estimated chronic levels of concern were exceeded for estuarine and marine invertebrates for turf, ornamentals, onions, and peaches at the maximum application rates and frequencies listed on the TM product label. These estimates are based on the assumption that the surrogate species tested to derive the toxicity endpoint

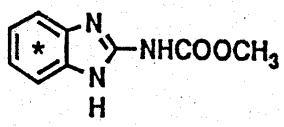
is representative of all species of that class.

In the absence of monitored levels of TM and MBC in ground water, the SCI-GROW model was used to estimate the potential ground water concentrations for ornamentals, the crop with the highest application rate listed on the TM label. Estimates of ground water concentrations based on the SCI-GROW model indicate that application of TM at maximum label rates is unlikely to exceed a maximum 90-day average concentration of 0.176 ppb for TM and 8.57 ppb for MBC. Ground water contamination is not expected to be a concern for TM because of TM's fairly rapid conversion to MBC in the aquatic environment under most agricultural conditions. MBC is very persistent but is relatively immobile in sandy loam or silt loam soils, and is likely to remain in the upper soil profile of these and similar soils. However, MBC has potential to leach to groundwater in highly sandy soils with low organic matter.

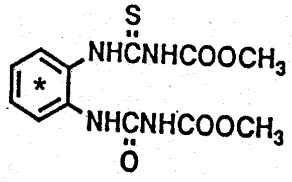
The estimated half-life of 320 days for MBC derived from the aerobic metabolism study differs greatly from the estimated half-life of 15 to 94 days based on terrestrial field dissipation studies. Site-specific parameters such as slope and climate may have influenced the more rapid dissipation of MBC in the field than degradation rates observed in laboratory studies. The wide range of estimated half-lives from terrestrial field dissipation studies for MBC indicates high variability in dissipation of TM among the sites studied. Volatilization from soil is not expected to be a significant dissipation mechanism for TM or MBC.

APPENDIX 1, TM DEGRADATES

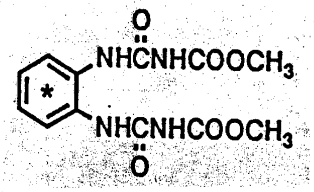
MBC: methyl 2-benzimidazolylcarbamate



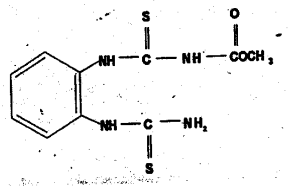
DX-105: methyl N-[2-(N-methoxycarbonylthioureido) phenylaminocarbonyl]carbamate



FH-432: deimethyl[(1,2-phenylene)bis(iminocarbonyl)]biscarbamate



AV-1951: methyl N-[2-(thioureido)phenylaminocarbo thioyl]carbamate



APPENDIX 2: LITERATURE CITED IN TM EFED SCIENCE CHAPTER

Barrett, M., 1997, Proposal For a Method to Determine Screening Concentration Estimates for Drinking Water Derived from Groundwater Studies, EFED/OPP.

Parker, Ronald D., Nelson, Nelson P., and Jones D. 1995. GENEEC: A screening Model for Pesticide Environmental Exposure Assessment. The International Symposium on Water Quality Monitoring. American Society of Agricultural Engineers.

Pfeiffer, D. 1992. 1992 Spray Bulletin for Commercial Fruit Growers. VA and WVA Cooperative Extension Services. Publ. 456-419. Pgs. 13, 45, and 52.

World Health Organization (WHO). 1993. Environmental Health Criteria 149: Carbendazim. Geneva, Switzerland - WHO. Pgs. 1-132.

U.S GS. 1992. National Water Quality Assessment (NWQA), Pesticides National Synthesis Project, Annual Use: Benomyl.

U.S GS. 1992. National Water Quality Assessment (NWQA), Pesticides National Synthesis Project, Annual Use: Thiophanate-methyl.

APPENDIX 3: GENEEC RUNS FOR TM AND MBC

GENEEC RUNS FOR TM

GENEEC RUN FOR **TM** ON **Turf**

RUN No. 1 FOR TM INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
76.600(76.605)	6 14	314.0	21.8	1.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
1.00	0	36.00	2.48- 304.30	.00	32.19

GENERIC EECs (IN **PPM**)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56
2.13	2.04	1.64	1.12

GENEEC RUN FOR **TM** ON **Ornamentals**

RUN No. 1 FOR tm INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
100.000(100.787)	3 7	314.0	21.8	5.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
1.00	0	36.00	2.48-	304.30	.00	32.19

GENERIC EECs (IN **PPM**)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56 DAY GEEC
3.22	3.11	2.50	1.71

GENEEC RUNS FOR MBC

GENEEC RUN FOR **MBC** ON **Turf**

RUN No. 1 FOR mbc INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
35.500(197.714)	6 14	1885.0	8.0	1.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
320.00	0	N/A	.00-	.00	61.00	61.00

GENERIC EECs (IN **PPM**)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56 DAY GEEC
1.61	1.52	1.12	.73

GENEEC RUN FOR **MBC** ON **Ornamentals**

RUN No. 1 FOR mbc INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
46.300(136.820)	3 7	1885.0	8.0	5.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
320.00	0	N/A	.00- .00	61.00	61.00

GENERIC EECs (IN **PPM**)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56 DAY GEEC
1.36	1.29	.95	.61

SCI-GROW Runs for TM

RUN No. 1 FOR tm INPUT VALUES

APPL (#/AC) RATE	APPL. NO. (#/AC/YR)	URATE	SOIL KOC	SOIL METABOLISM (DAYS)	AEROBIC
100.000	3	300.000	314.0	1.0	

GROUND-WATER SCREENING CONCENTRATIONS IN **PPB**

.111594

A= .167 B= 319.000 C= -.778 D= 2.504 RILP= -1.948
F= -3.429 G= .000 URATE= 300.000 GWSC= .111594

SCI-GROW Runs for MBC

RUN No. 1 FOR mbc INPUT VALUES

APPL (#/AC) RATE	APPL. NO. (#/AC/YR)	URATE	SOIL KOC	SOIL METABOLISM (DAYS)	AEROBIC
46.300	3	138.900	1885.0	320.0	

GROUND-WATER SCREENING CONCENTRATIONS IN **PPB**

10.100720

A= 315.000 B= 1890.000 C= 2.498 D= 3.276 RILP= 1.808
F= -1.138 G= .073 URATE= 138.900 GWSC= 10.100720

APPENDIX 4: PRZM/EXAMS input and out put files FOR TM AND MBC

TM On Peaches input file

```
*** PRZM 3.1 Input File Converted from PRZM 2.3***
*** TMPEACH1.INP; January 29, 1998; scenario for TM use patterns ***
*** TM applied to peaches by aerial method***
*** Peach Co, Georgia; MLRA P133A;  Crop: Peaches***
*** Weather form MLRA P137 was used rather than P133A as Augusta was more***
*** appropriate than Birmingham for this site.***
*** Emergence date set at flower bud, maturation at beginning of harvest, harvest
at end of harvest***
*** Growth cycle information from Mark Collier, Extension Agent, Peach County,
GA***
*** Assume fair grass coverage under trees; no channel, flow is overland***
Thiophanate methyl (TM)
Boswell Sandy Laom; MLRA P-133A, Birmingham, Georgia, Peach
   0.750   0.150       0   17.00       1       1
       4
    0.19    3.30    1.00   10.00    5.80       3    4.00   356.8
       1
       1    0.25   17.00  100.00       1  94  78  78                0.00     600
       1       3
0110  0103  0108
0.74  0.01  0.01
0.03  0.03  0.03
      34
  010350  150550  310850   1
  010351  150551  310851   1
  010352  150552  310852   1
  010353  150553  310853   1
  010354  150554  310854   1
  010355  150555  310855   1
  010356  150556  310856   1
  010357  150557  310857   1
  010358  150558  310858   1
  010359  150559  310859   1
  010360  150560  310860   1
  010361  150561  310861   1
  010362  150562  310862   1
  010363  150563  310863   1
  010364  150564  310864   1
  010365  150565  310865   1
  010366  150566  310866   1
  010367  150567  310867   1
  010368  150568  310868   1
  010369  150569  310869   1
  010370  150570  310870   1
  010371  150571  310871   1
  010372  150572  310872   1
  010373  150573  310873   1
  010374  150574  310874   1
  010375  150575  310875   1
  010376  150576  310876   1
  010377  150577  310877   1
  010378  150578  310878   1
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  010379  150579  310879   1
  010380  150580  310880   1
  010381  150581  310881   1
  010382  150582  310882   1
  010383  150583  310883   1
Application Schedule: 12 app., 1.6 lb a.i./acre, aerial Spray @ 95% eff. w/0.16
drift
     408       1       0       0
Thiophanate methyl Koc 314 (sandy loam) ASM: T1/2 = 1 day; AnSM: T1/2 = stable
  100350  0 2 1.00  1.80 0.95 0.16
  200350  0 2 1.00  1.80 0.95 0.16
  300350  0 2 1.00  1.80 0.95 0.16
  100450  0 2 1.00  1.80 0.95 0.16
  200450  0 2 1.00  1.80 0.95 0.16
  300450  0 2 1.00  1.80 0.95 0.16
  090550  0 2 1.00  1.80 0.95 0.16
  190550  0 2 1.00  1.80 0.95 0.16
  290550  0 2 1.00  1.80 0.95 0.16
  080650  0 2 1.00  1.80 0.95 0.16
  180650  0 2 1.00  1.80 0.95 0.16
  280650  0 2 1.00  1.80 0.95 0.16
  100351  0 2 1.00  1.80 0.95 0.16
  200351  0 2 1.00  1.80 0.95 0.16
  300351  0 2 1.00  1.80 0.95 0.16
  100451  0 2 1.00  1.80 0.95 0.16
  200451  0 2 1.00  1.80 0.95 0.16
  300451  0 2 1.00  1.80 0.95 0.16
  090551  0 2 1.00  1.80 0.95 0.16
  190551  0 2 1.00  1.80 0.95 0.16
  290551  0 2 1.00  1.80 0.95 0.16
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  180651  0 2 1.00  1.80 0.95 0.16
  280651  0 2 1.00  1.80 0.95 0.16
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  200352  0 2 1.00  1.80 0.95 0.16
  300352  0 2 1.00  1.80 0.95 0.16
  100452  0 2 1.00  1.80 0.95 0.16
  200452  0 2 1.00  1.80 0.95 0.16
  300452  0 2 1.00  1.80 0.95 0.16
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  190552  0 2 1.00  1.80 0.95 0.16
  290552  0 2 1.00  1.80 0.95 0.16
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  180652  0 2 1.00  1.80 0.95 0.16
  280652  0 2 1.00  1.80 0.95 0.16
  100353  0 2 1.00  1.80 0.95 0.16
  200353  0 2 1.00  1.80 0.95 0.16
  300353  0 2 1.00  1.80 0.95 0.16
  100453  0 2 1.00  1.80 0.95 0.16
  200453  0 2 1.00  1.80 0.95 0.16
  300453  0 2 1.00  1.80 0.95 0.16
  090553  0 2 1.00  1.80 0.95 0.16
  190553  0 2 1.00  1.80 0.95 0.16
  290553  0 2 1.00  1.80 0.95 0.16
  080653  0 2 1.00  1.80 0.95 0.16
  180653  0 2 1.00  1.80 0.95 0.16
  280653  0 2 1.00  1.80 0.95 0.16
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200454  0 2 1.00  1.80 0.95 0.16
300454  0 2 1.00  1.80 0.95 0.16
090554  0 2 1.00  1.80 0.95 0.16
190554  0 2 1.00  1.80 0.95 0.16
290554  0 2 1.00  1.80 0.95 0.16
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200355  0 2 1.00  1.80 0.95 0.16
300355  0 2 1.00  1.80 0.95 0.16
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200455  0 2 1.00  1.80 0.95 0.16
300455  0 2 1.00  1.80 0.95 0.16
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200358  0 2 1.00  1.80 0.95 0.16
300358  0 2 1.00  1.80 0.95 0.16
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200359  0 2 1.00  1.80 0.95 0.16
300359  0 2 1.00  1.80 0.95 0.16
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180659  0 2 1.00  1.80 0.95 0.16
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190560  0 2 1.00  1.80 0.95 0.16
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090564  0 2 1.00  1.80 0.95 0.16
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280664  0 2 1.00  1.80 0.95 0.16
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090567  0 2 1.00  1.80 0.95 0.16
190567  0 2 1.00  1.80 0.95 0.16
290567  0 2 1.00  1.80 0.95 0.16
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180667  0 2 1.00  1.80 0.95 0.16
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300368  0 2 1.00  1.80 0.95 0.16
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090568  0 2 1.00  1.80 0.95 0.16
190568  0 2 1.00  1.80 0.95 0.16
290568  0 2 1.00  1.80 0.95 0.16
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300369  0 2 1.00  1.80 0.95 0.16
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090569  0 2 1.00  1.80 0.95 0.16
190569  0 2 1.00  1.80 0.95 0.16
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180669  0 2 1.00  1.80 0.95 0.16
280669  0 2 1.00  1.80 0.95 0.16
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200370  0 2 1.00  1.80 0.95 0.16
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200371  0 2 1.00  1.80 0.95 0.16
300371  0 2 1.00  1.80 0.95 0.16
100471  0 2 1.00  1.80 0.95 0.16
200471  0 2 1.00  1.80 0.95 0.16
300471  0 2 1.00  1.80 0.95 0.16
090571  0 2 1.00  1.80 0.95 0.16
190571  0 2 1.00  1.80 0.95 0.16
290571  0 2 1.00  1.80 0.95 0.16
080671  0 2 1.00  1.80 0.95 0.16
180671  0 2 1.00  1.80 0.95 0.16
280671  0 2 1.00  1.80 0.95 0.16
100372  0 2 1.00  1.80 0.95 0.16
200372  0 2 1.00  1.80 0.95 0.16
300372  0 2 1.00  1.80 0.95 0.16
100472  0 2 1.00  1.80 0.95 0.16
200472  0 2 1.00  1.80 0.95 0.16
300472  0 2 1.00  1.80 0.95 0.16
090572  0 2 1.00  1.80 0.95 0.16
190572  0 2 1.00  1.80 0.95 0.16
290572  0 2 1.00  1.80 0.95 0.16
080672  0 2 1.00  1.80 0.95 0.16
180672  0 2 1.00  1.80 0.95 0.16
280672  0 2 1.00  1.80 0.95 0.16
```

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100373  0 2 1.00  1.80 0.95 0.16
200373  0 2 1.00  1.80 0.95 0.16
300373  0 2 1.00  1.80 0.95 0.16
100473  0 2 1.00  1.80 0.95 0.16
200473  0 2 1.00  1.80 0.95 0.16
300473  0 2 1.00  1.80 0.95 0.16
090573  0 2 1.00  1.80 0.95 0.16
190573  0 2 1.00  1.80 0.95 0.16
290573  0 2 1.00  1.80 0.95 0.16
080673  0 2 1.00  1.80 0.95 0.16
180673  0 2 1.00  1.80 0.95 0.16
280673  0 2 1.00  1.80 0.95 0.16
100374  0 2 1.00  1.80 0.95 0.16
200374  0 2 1.00  1.80 0.95 0.16
300374  0 2 1.00  1.80 0.95 0.16
100474  0 2 1.00  1.80 0.95 0.16
200474  0 2 1.00  1.80 0.95 0.16
300474  0 2 1.00  1.80 0.95 0.16
090574  0 2 1.00  1.80 0.95 0.16
190574  0 2 1.00  1.80 0.95 0.16
290574  0 2 1.00  1.80 0.95 0.16
080674  0 2 1.00  1.80 0.95 0.16
180674  0 2 1.00  1.80 0.95 0.16
280674  0 2 1.00  1.80 0.95 0.16
100375  0 2 1.00  1.80 0.95 0.16
200375  0 2 1.00  1.80 0.95 0.16
300375  0 2 1.00  1.80 0.95 0.16
100475  0 2 1.00  1.80 0.95 0.16
200475  0 2 1.00  1.80 0.95 0.16
300475  0 2 1.00  1.80 0.95 0.16
090575  0 2 1.00  1.80 0.95 0.16
190575  0 2 1.00  1.80 0.95 0.16
290575  0 2 1.00  1.80 0.95 0.16
080675  0 2 1.00  1.80 0.95 0.16
180675  0 2 1.00  1.80 0.95 0.16
280675  0 2 1.00  1.80 0.95 0.16
100376  0 2 1.00  1.80 0.95 0.16
200376  0 2 1.00  1.80 0.95 0.16
300376  0 2 1.00  1.80 0.95 0.16
100476  0 2 1.00  1.80 0.95 0.16
200476  0 2 1.00  1.80 0.95 0.16
300476  0 2 1.00  1.80 0.95 0.16
090576  0 2 1.00  1.80 0.95 0.16
190576  0 2 1.00  1.80 0.95 0.16
290576  0 2 1.00  1.80 0.95 0.16
080676  0 2 1.00  1.80 0.95 0.16
180676  0 2 1.00  1.80 0.95 0.16
280676  0 2 1.00  1.80 0.95 0.16
100377  0 2 1.00  1.80 0.95 0.16
200377  0 2 1.00  1.80 0.95 0.16
300377  0 2 1.00  1.80 0.95 0.16
100477  0 2 1.00  1.80 0.95 0.16
200477  0 2 1.00  1.80 0.95 0.16
300477  0 2 1.00  1.80 0.95 0.16
090577  0 2 1.00  1.80 0.95 0.16
190577  0 2 1.00  1.80 0.95 0.16
290577  0 2 1.00  1.80 0.95 0.16
```

```
080677  0 2 1.00  1.80 0.95 0.16
180677  0 2 1.00  1.80 0.95 0.16
280677  0 2 1.00  1.80 0.95 0.16
100378  0 2 1.00  1.80 0.95 0.16
200378  0 2 1.00  1.80 0.95 0.16
300378  0 2 1.00  1.80 0.95 0.16
100478  0 2 1.00  1.80 0.95 0.16
200478  0 2 1.00  1.80 0.95 0.16
300478  0 2 1.00  1.80 0.95 0.16
090578  0 2 1.00  1.80 0.95 0.16
190578  0 2 1.00  1.80 0.95 0.16
290578  0 2 1.00  1.80 0.95 0.16
080678  0 2 1.00  1.80 0.95 0.16
180678  0 2 1.00  1.80 0.95 0.16
280678  0 2 1.00  1.80 0.95 0.16
100379  0 2 1.00  1.80 0.95 0.16
200379  0 2 1.00  1.80 0.95 0.16
300379  0 2 1.00  1.80 0.95 0.16
100479  0 2 1.00  1.80 0.95 0.16
200479  0 2 1.00  1.80 0.95 0.16
300479  0 2 1.00  1.80 0.95 0.16
090579  0 2 1.00  1.80 0.95 0.16
190579  0 2 1.00  1.80 0.95 0.16
290579  0 2 1.00  1.80 0.95 0.16
080679  0 2 1.00  1.80 0.95 0.16
180679  0 2 1.00  1.80 0.95 0.16
280679  0 2 1.00  1.80 0.95 0.16
100380  0 2 1.00  1.80 0.95 0.16
200380  0 2 1.00  1.80 0.95 0.16
300380  0 2 1.00  1.80 0.95 0.16
100480  0 2 1.00  1.80 0.95 0.16
200480  0 2 1.00  1.80 0.95 0.16
300480  0 2 1.00  1.80 0.95 0.16
090580  0 2 1.00  1.80 0.95 0.16
190580  0 2 1.00  1.80 0.95 0.16
290580  0 2 1.00  1.80 0.95 0.16
080680  0 2 1.00  1.80 0.95 0.16
180680  0 2 1.00  1.80 0.95 0.16
280680  0 2 1.00  1.80 0.95 0.16
100381  0 2 1.00  1.80 0.95 0.16
200381  0 2 1.00  1.80 0.95 0.16
300381  0 2 1.00  1.80 0.95 0.16
100481  0 2 1.00  1.80 0.95 0.16
200481  0 2 1.00  1.80 0.95 0.16
300481  0 2 1.00  1.80 0.95 0.16
090581  0 2 1.00  1.80 0.95 0.16
190581  0 2 1.00  1.80 0.95 0.16
290581  0 2 1.00  1.80 0.95 0.16
080681  0 2 1.00  1.80 0.95 0.16
180681  0 2 1.00  1.80 0.95 0.16
280681  0 2 1.00  1.80 0.95 0.16
100382  0 2 1.00  1.80 0.95 0.16
200382  0 2 1.00  1.80 0.95 0.16
300382  0 2 1.00  1.80 0.95 0.16
100482  0 2 1.00  1.80 0.95 0.16
200482  0 2 1.00  1.80 0.95 0.16
300482  0 2 1.00  1.80 0.95 0.16
```

```
  090582  0 2 1.00  1.80 0.95 0.16
  190582  0 2 1.00  1.80 0.95 0.16
  290582  0 2 1.00  1.80 0.95 0.16
  080682  0 2 1.00  1.80 0.95 0.16
  180682  0 2 1.00  1.80 0.95 0.16
  280682  0 2 1.00  1.80 0.95 0.16
  100383  0 2 1.00  1.80 0.95 0.16
  200383  0 2 1.00  1.80 0.95 0.16
  300383  0 2 1.00  1.80 0.95 0.16
  100483  0 2 1.00  1.80 0.95 0.16
  200483  0 2 1.00  1.80 0.95 0.16
  300483  0 2 1.00  1.80 0.95 0.16
  090583  0 2 1.00  1.80 0.95 0.16
  190583  0 2 1.00  1.80 0.95 0.16
  290583  0 2 1.00  1.80 0.95 0.16
  080683  0 2 1.00  1.80 0.95 0.16
  180683  0 2 1.00  1.80 0.95 0.16
  280683  0 2 1.00  1.80 0.95 0.16
    0.00       3    0.00
    0.00    0.02    0.50
Boswell sandy loam; Hydrologic Group D
     100           0   0   1   0   0   0   0   0   0
     0.0    0.00    0.00
       4     314
       3
       1   00.20   1.700   0.213   0.000   0.000
           0.693   0.693   0.000
             0.1   0.213   0.063   0.800   0.000
       2   11.80   1.700   0.213   0.000   0.000
           0.693   0.693   0.000
             0.1   0.213   0.063   0.800   0.000
       3   88.00   1.700   0.354   0.000   0.000
           0.693   0.693   0.000
              2   0.354   0.213   0.800   0.000
       0
            YEAR       5            YEAR       5            YEAR       5   1
       1
       1  -----
       6    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    ESLS    TCUM   0   0   1.0E3
    RFLX    TCUM   0   0   1.0E5
    EFLX    TCUM   0   0   1.0E5
    RZFX    TCUM   0   0   1.0E5
```

TM On Peaches output file

WATER COLUMN DISSOLVED CONCENTRATION (**PPB**)

YEAR	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
1950	17.540	12.570	8.031	7.127	6.588	2.251
1951	21.270	15.240	8.618	7.431	6.715	2.114
1952	17.810	12.760	8.239	7.301	6.797	2.250
1953	22.170	14.340	8.314	7.586	6.838	2.192
1954	17.550	12.580	8.042	7.141	6.749	2.219
1955	18.660	12.610	9.021	7.783	7.082	2.375
1956	19.970	14.800	8.670	7.735	6.917	2.244
1957	17.960	12.810	8.371	7.608	6.936	2.127
1958	17.830	12.780	8.064	7.360	6.667	2.112
1959	20.190	14.530	8.663	7.604	6.951	2.165
1960	29.430	21.100	10.580	8.219	7.485	2.310
1961	25.210	18.560	10.710	9.161	7.912	2.520
1962	19.600	14.940	10.070	8.176	7.234	2.349
1963	25.010	16.110	8.732	7.751	6.962	2.278
1964	25.360	17.250	10.230	8.427	7.729	2.497
1965	19.210	13.420	8.293	7.271	6.677	2.311
1966	17.540	12.570	8.031	7.192	6.782	2.164
1967	106.000	77.080	33.110	16.240	13.730	3.885
1968	20.940	12.570	8.031	7.123	6.891	2.206
1969	18.870	12.750	8.733	7.698	6.984	2.279
1970	36.640	26.270	13.700	9.340	7.989	2.510
1971	18.620	13.350	8.571	7.620	7.052	2.203
1972	27.440	17.300	8.191	7.217	6.571	2.342
1973	23.630	17.670	9.676	8.002	7.214	2.373
1974	17.550	12.570	8.034	7.274	6.622	2.152
1975	17.700	12.690	8.255	7.423	6.810	2.198
1976	17.690	12.620	8.207	7.255	6.787	2.175
1977	32.130	23.410	12.890	8.956	7.756	2.363
1978	17.870	12.800	8.191	7.355	6.664	2.175
1979	17.700	12.690	8.155	7.435	7.118	2.408
1980	28.780	17.820	12.680	9.012	7.768	2.537
1981	63.220	37.210	13.440	8.860	8.361	2.868
1982	20.620	12.570	8.031	7.210	6.711	2.184

1983 17.780 12.600 8.110 7.248 6.651 2.151

SORTED FOR PLOTTING

PROB	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
0.029	106.000	77.080	33.110	16.240	13.730	3.885
0.057	63.220	37.210	13.700	9.340	8.361	2.868
0.086	36.640	26.270	13.440	9.161	7.989	2.537
0.114	32.130	23.410	12.890	9.012	7.912	2.520
0.143	29.430	21.100	12.680	8.956	7.768	2.510
0.171	28.780	18.560	10.710	8.860	7.756	2.497
0.200	27.440	17.820	10.580	8.427	7.729	2.408
0.229	25.360	17.670	10.230	8.219	7.485	2.375
0.257	25.210	17.300	10.070	8.176	7.234	2.373
0.286	25.010	17.250	9.676	8.002	7.214	2.363
0.314	23.630	16.110	9.021	7.783	7.118	2.349
0.343	22.170	15.240	8.733	7.751	7.082	2.342
0.371	21.270	14.940	8.732	7.735	7.052	2.311
0.400	20.940	14.800	8.670	7.698	6.984	2.310
0.429	20.620	14.530	8.663	7.620	6.962	2.279
0.457	20.190	14.340	8.618	7.608	6.951	2.278
0.486	19.970	13.420	8.571	7.604	6.936	2.251
0.514	19.600	13.350	8.371	7.586	6.917	2.250
0.543	19.210	12.810	8.314	7.435	6.891	2.244
0.571	18.870	12.800	8.293	7.431	6.838	2.219
0.600	18.660	12.780	8.255	7.423	6.810	2.206
0.629	18.620	12.760	8.239	7.360	6.797	2.203
0.657	17.960	12.750	8.207	7.355	6.787	2.198
0.686	17.870	12.690	8.191	7.301	6.782	2.192
0.714	17.830	12.690	8.191	7.274	6.749	2.184
0.743	17.810	12.620	8.155	7.271	6.715	2.175
0.771	17.780	12.610	8.110	7.255	6.711	2.175
0.800	17.700	12.600	8.064	7.248	6.677	2.165
0.829	17.700	12.580	8.042	7.217	6.667	2.164
0.857	17.690	12.570	8.034	7.210	6.664	2.152
0.886	17.550	12.570	8.031	7.192	6.651	2.151
0.914	17.550	12.570	8.031	7.141	6.622	2.127
0.943	17.540	12.570	8.031	7.127	6.588	2.114
0.971	17.540	12.570	8.031	7.123	6.571	2.112
1/10	34.385	24.840	13.165	9.087	7.950	2.529

MEAN OF ANNUAL VALUES = 2.338

STANDARD DEVIATION OF ANNUAL VALUES = 0.316

UPPER 90% CONFIDENCE LIMIT ON MEAN = 2.418

TM On Soybeans input file

```
Thiophanate methyl (TM)
Location: MLRA: P-133A; Georgia
   0.750   0.150       0   17.00       1       3
```

```
       4
    0.42    1.00    1.00    10.0                3    2.00   354.0
       1
       1    0.20   22.00  100.00       3  91  85  88                0.00   80.00
       1       3
0101 0107 0109
0.50 0.50 0.50
.023 .023 .023
      36
   1 748  171048   11148   1
   1 749  171049   11149   1
   1 750  171050   11150   1
   1 751  171051   11151   1
   1 752  171052   11152   1
   1 753  171053   11153   1
   1 754  171054   11154   1
   1 755  171055   11155   1
   1 756  171056   11156   1
   1 757  171057   11157   1
   1 758  171058   11158   1
   1 759  171059   11159   1
   1 760  171060   11160   1
   1 761  171061   11161   1
   1 762  171062   11162   1
   1 763  171063   11163   1
   1 764  171064   11164   1
   1 765  171065   11165   1
   1 766  171066   11166   1
   1 767  171067   11167   1
   1 768  171068   11168   1
   1 769  171069   11169   1
   1 770  171070   11170   1
   1 771  171071   11171   1
   1 772  171072   11172   1
   1 773  171073   11173   1
   1 774  171074   11174   1
   1 775  171075   11175   1
   1 776  171076   11176   1
   1 777  171077   11177   1
   1 778  171078   11178   1
   1 779  171079   11179   1
   1 780  171080   11180   1
   1 781  171081   11181   1
   1 782  171082   11182   1
   1 783  171083   11183   1
Application Schedule: 2 aerial appl. (4-day interval) @1.05 lb ai/acre.
      72       1       0       0
TM  KOC:314   ; AESM T1/2=
  080848  0 2 0.00  1.18 0.95 0.16
  120848  0 2 0.00  1.18 0.95 0.16
  080849  0 2 0.00  1.18 0.95 0.16
  120849  0 2 0.00  1.18 0.95 0.16
  080850  0 2 0.00  1.18 0.95 0.16
  120850  0 2 0.00  1.18 0.95 0.16
  080851  0 2 0.00  1.18 0.95 0.16
  120851  0 2 0.00  1.18 0.95 0.16
  080852  0 2 0.00  1.18 0.95 0.16
```

```
120852  0 2 0.00  1.18 0.95 0.16
080853  0 2 0.00  1.18 0.95 0.16
120853  0 2 0.00  1.18 0.95 0.16
080854  0 2 0.00  1.18 0.95 0.16
120854  0 2 0.00  1.18 0.95 0.16
080855  0 2 0.00  1.18 0.95 0.16
120855  0 2 0.00  1.18 0.95 0.16
080856  0 2 0.00  1.18 0.95 0.16
120856  0 2 0.00  1.18 0.95 0.16
080857  0 2 0.00  1.18 0.95 0.16
120857  0 2 0.00  1.18 0.95 0.16
080858  0 2 0.00  1.18 0.95 0.16
120858  0 2 0.00  1.18 0.95 0.16
080859  0 2 0.00  1.18 0.95 0.16
120859  0 2 0.00  1.18 0.95 0.16
080860  0 2 0.00  1.18 0.95 0.16
120860  0 2 0.00  1.18 0.95 0.16
080861  0 2 0.00  1.18 0.95 0.16
120861  0 2 0.00  1.18 0.95 0.16
080862  0 2 0.00  1.18 0.95 0.16
120862  0 2 0.00  1.18 0.95 0.16
080863  0 2 0.00  1.18 0.95 0.16
120863  0 2 0.00  1.18 0.95 0.16
080864  0 2 0.00  1.18 0.95 0.16
120864  0 2 0.00  1.18 0.95 0.16
080865  0 2 0.00  1.18 0.95 0.16
120865  0 2 0.00  1.18 0.95 0.16
080866  0 2 0.00  1.18 0.95 0.16
120866  0 2 0.00  1.18 0.95 0.16
080867  0 2 0.00  1.18 0.95 0.16
120867  0 2 0.00  1.18 0.95 0.16
080868  0 2 0.00  1.18 0.95 0.16
120868  0 2 0.00  1.18 0.95 0.16
080869  0 2 0.00  1.18 0.95 0.16
120869  0 2 0.00  1.18 0.95 0.16
080870  0 2 0.00  1.18 0.95 0.16
120870  0 2 0.00  1.18 0.95 0.16
080871  0 2 0.00  1.18 0.95 0.16
120871  0 2 0.00  1.18 0.95 0.16
080872  0 2 0.00  1.18 0.95 0.16
120872  0 2 0.00  1.18 0.95 0.16
080873  0 2 0.00  1.18 0.95 0.16
120873  0 2 0.00  1.18 0.95 0.16
080874  0 2 0.00  1.18 0.95 0.16
120874  0 2 0.00  1.18 0.95 0.16
080875  0 2 0.00  1.18 0.95 0.16
120875  0 2 0.00  1.18 0.95 0.16
080876  0 2 0.00  1.18 0.95 0.16
120876  0 2 0.00  1.18 0.95 0.16
080877  0 2 0.00  1.18 0.95 0.16
120877  0 2 0.00  1.18 0.95 0.16
080878  0 2 0.00  1.18 0.95 0.16
120878  0 2 0.00  1.18 0.95 0.16
080879  0 2 0.00  1.18 0.95 0.16
120879  0 2 0.00  1.18 0.95 0.16
080880  0 2 0.00  1.18 0.95 0.16
120880  0 2 0.00  1.18 0.95 0.16
```

```
  080881  0 2 0.00  1.18 0.95 0.16
  120881  0 2 0.00  1.18 0.95 0.16
  080882  0 2 0.00  1.18 0.95 0.16
  120882  0 2 0.00  1.18 0.95 0.16
  080883  0 2 0.00  1.18 0.95 0.16
  120883  0 2 0.00  1.18 0.95 0.16
     0.0       3     0.0
    0.00   0.000     0.5
LYNCHBERG LOAMY SAND; HYDROLOGIC GROUP C
  100.00           0   0   1   0   0   0   0   0   0
     0.0     0.0     0.0
       4     314
       2
       1   26.00   1.700   0.140   0.000   0.000   0.000
           0.693   0.693   0.000
           0.100   0.104   0.034   2.900   0.00
       2   74.00   1.500   0.232   0.000   0.000   0.000
           0.693   0.693   0.000
           1.000   0.232   0.112   0.174   0.000
       0
            YEAR       5            YEAR       5            YEAR       5   1
       1
       1  -----
       6    YEAR
    PRCP    TCUM   0   0
    RUNF    TCUM   0   0
    ESLS    TCUM   0   0   1.0E3
    RFLX    TCUM   0   0   1.0E5
    EFLX    TCUM   0   0   1.0E5
    RZFX    TCUM   0   0   1.0E5
```

TM On Soybeans output file

PRZM/EXAMS Run for TM on GA Soybeans

WATER COLUMN DISSOLVED CONCENTRATION (PPB)

YEAR	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
1948	11.040	5.230	2.064	0.741	0.494	0.153
1949	11.020	5.222	2.049	0.718	0.479	0.135
1950	11.020	5.222	2.046	0.860	0.573	0.164
1951	11.020	5.222	2.046	0.731	0.487	0.134
1952	11.270	5.339	2.148	0.752	0.502	0.150
1953	11.020	5.222	2.078	0.750	0.501	0.138
1954	11.020	5.222	2.047	0.717	0.479	0.151
1955	11.020	5.223	2.048	0.717	0.478	0.131
1956	11.020	5.383	2.089	0.734	0.490	0.148
1957	11.020	5.222	2.154	0.763	0.509	0.146
1958	11.020	5.222	2.046	0.726	0.484	0.135
1959	11.020	5.222	2.046	0.728	0.486	0.130
1960	11.450	5.506	2.194	0.774	0.516	0.190
1961	11.020	5.222	2.088	0.820	0.547	0.154
1962	11.020	6.117	2.295	0.804	0.536	0.178
1963	11.020	5.296	2.075	0.738	0.493	0.152
1964	11.590	5.491	2.111	0.789	0.526	0.149
1965	11.270	5.341	2.117	0.743	0.495	0.148
1966	11.020	5.222	2.046	0.768	0.512	0.137
1967	11.020	5.222	2.059	0.724	0.483	0.131
1968	11.020	5.222	2.046	0.723	0.483	0.132
1969	11.020	5.229	2.055	0.724	0.483	0.151
1970	11.020	5.222	2.050	0.720	0.480	0.131
1971	11.020	5.222	2.046	0.776	0.517	0.141
1972	11.030	5.226	2.148	0.753	0.502	0.145
1973	11.060	5.241	2.063	0.726	0.484	0.148
1974	11.720	5.562	2.336	0.825	0.550	0.147
1975	11.030	5.228	2.050	0.739	0.493	0.144
1976	11.020	5.222	2.048	0.732	0.488	0.133
1977	11.020	5.222	2.046	0.742	0.495	0.133
1978	12.080	6.707	2.485	0.876	0.585	0.178
1979	11.020	5.222	2.047	0.719	0.479	0.136
1980	11.020	5.222	2.046	0.726	0.486	0.132
1981	11.640	5.515	2.121	0.743	0.495	0.137
1982	11.020	5.222	2.538	0.891	0.594	0.165
1983	11.020	5.222	2.079	0.733	0.489	0.133

SORTED FOR PLOTTING

PROB	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
0.027	12.080	6.707	2.538	0.891	0.594	0.190
0.054	11.720	6.117	2.485	0.876	0.585	0.178
0.081	11.640	5.562	2.336	0.860	0.573	0.178
0.108	11.590	5.515	2.295	0.825	0.550	0.165
0.135	11.450	5.506	2.194	0.820	0.547	0.164
0.162	11.270	5.491	2.154	0.804	0.536	0.154
0.189	11.270	5.383	2.148	0.789	0.526	0.153
0.216	11.060	5.341	2.148	0.776	0.517	0.152
0.243	11.040	5.339	2.121	0.774	0.516	0.151
0.270	11.030	5.296	2.117	0.768	0.512	0.151
0.297	11.030	5.241	2.111	0.763	0.509	0.150
0.324	11.020	5.230	2.089	0.753	0.502	0.149
0.351	11.020	5.229	2.088	0.752	0.502	0.148
0.378	11.020	5.228	2.079	0.750	0.501	0.148
0.405	11.020	5.226	2.078	0.743	0.495	0.148
0.432	11.020	5.223	2.075	0.743	0.495	0.147
0.459	11.020	5.222	2.064	0.742	0.495	0.146
0.486	11.020	5.222	2.063	0.741	0.494	0.145
0.514	11.020	5.222	2.059	0.739	0.493	0.144
0.541	11.020	5.222	2.055	0.738	0.493	0.141
0.568	11.020	5.222	2.050	0.734	0.490	0.138
0.595	11.020	5.222	2.050	0.733	0.489	0.137
0.622	11.020	5.222	2.049	0.732	0.488	0.137
0.649	11.020	5.222	2.048	0.731	0.487	0.136
0.676	11.020	5.222	2.048	0.728	0.486	0.135
0.703	11.020	5.222	2.047	0.726	0.486	0.135
0.730	11.020	5.222	2.047	0.726	0.484	0.134
0.757	11.020	5.222	2.046	0.726	0.484	0.133
0.784	11.020	5.222	2.046	0.724	0.483	0.133
0.811	11.020	5.222	2.046	0.724	0.483	0.133
0.838	11.020	5.222	2.046	0.723	0.483	0.132
0.865	11.020	5.222	2.046	0.720	0.480	0.132
0.892	11.020	5.222	2.046	0.719	0.479	0.131
0.919	11.020	5.222	2.046	0.718	0.479	0.131
0.946	11.020	5.222	2.046	0.717	0.479	0.131
0.973	11.020	5.222	2.046	0.717	0.478	0.130
1/10	11.605	5.529	2.307	0.836	0.557	0.169

MEAN OF ANNUAL VALUES = 0.146

STANDARD DEVIATION OF ANNUAL VALUES = 0.015

UPPER 90% CONFIDENCE LIMIT ON MEAN = 0.149

TM On Onions input file

```
*** PRZM 3.12 Input Data File converted from PRZM 2.3
*** Converted from Grape scenario to Onion ********
*** TMCaOn.INP, created 2 July 1999; Stanislaus county, CA.***
*** Soil Hanford, Hydrologic Group B ***
*** Assume poor grass coverage under vines and overland flow***
*** Pesticide is ground spray applied in furrows***
*** This is intended to use a modified metfile, incorporating irrigation ***
*** cropping curve number reduced from 78 to fit the 15% of flood irrigation ***
*** water which runs off. The 15% number comes from Terry Pritchard, ***
*** San Joachin county cooperative extension, (209) 468-2085 ***
TM
Hanford fine sandyloam; MLRA L-17, Stanislaus County, CA.
   0.852   0.450       0   15.00       1       3
       4
    0.34    0.15    1.00     172    5.80       3   0.500   464.0
       1
       1    0.25   90.00  100.00       3  86  59  82                0.00    35.0
       1       3
0101 0110 0111
0.05 0.05 0.05
.023 .023 .023
      36
  060948  150449  010549       1
  070949  150450  010550       1
  070950  150451  010551       1
  070951  150452  010552       1
  070952  150453  010553       1
  070953  150454  010554       1
  070954  150455  010555       1
  070955  150456  010556       1
  070956  150457  010557       1
  070957  150458  010558       1
  070958  150459  010559       1
  070959  150460  010560       1
  070960  150461  010561       1
  070961  150462  010562       1
  070962  150463  010563       1
  070963  150464  010564       1
  070964  150465  010565       1
  070965  150466  010566       1
  070966  150467  010567       1
  070967  150468  010568       1
  070968  150469  010569       1
  070969  150470  010570       1
```

```
  070970  150471  010571       1
  070971  150472  010572       1
  070972  150473  010573       1
  070973  150474  010574       1
  070974  150475  010575       1
  070975  150476  010576       1
  070976  150477  010577       1
  070977  150478  010578       1
  070978  150479  010579       1
  070979  150480  010580       1
  070980  150481  010581       1
  070981  150482  010582       1
  070982  150483  010583       1
  070983  150484  010584       1
Application Schedule: 1 ground spray app, 11.2 lb a.i./acre, eff. 0.99, spray
drift 0.064.
      36       1       0       0
Koc 314; ASM: T1/2 = 1 days; AnSM: T1/2 =  days
  070948  0 5  1.3 12.54 0.99 0.064
  070949  0 5  1.3 12.54 0.99 0.064
  070950  0 5  1.3 12.54 0.99 0.064
  070951  0 5  1.3 12.54 0.99 0.064
  070952  0 5  1.3 12.54 0.99 0.064
  070953  0 5  1.3 12.54 0.99 0.064
  070954  0 5  1.3 12.54 0.99 0.064
  070955  0 5  1.3 12.54 0.99 0.064
  070956  0 5  1.3 12.54 0.99 0.064
  070957  0 5  1.3 12.54 0.99 0.064
  070958  0 5  1.3 12.54 0.99 0.064
  070959  0 5  1.3 12.54 0.99 0.064
  070960  0 5  1.3 12.54 0.99 0.064
  070961  0 5  1.3 12.54 0.99 0.064
  070962  0 5  1.3 12.54 0.99 0.064
  070963  0 5  1.3 12.54 0.99 0.064
  070964  0 5  1.3 12.54 0.99 0.064
  070965  0 5  1.3 12.54 0.99 0.064
  070966  0 5  1.3 12.54 0.99 0.064
  070967  0 5  1.3 12.54 0.99 0.064
  070968  0 5  1.3 12.54 0.99 0.064
  070969  0 5  1.3 12.54 0.99 0.064
  070970  0 5  1.3 12.54 0.99 0.064
  070971  0 5  1.3 12.54 0.99 0.064
  070972  0 5  1.3 12.54 0.99 0.064
  070973  0 5  1.3 12.54 0.99 0.064
  070974  0 5  1.3 12.54 0.99 0.064
  070975  0 5  1.3 12.54 0.99 0.064
  070976  0 5  1.3 12.54 0.99 0.064
  070977  0 5  1.3 12.54 0.99 0.064
  070978  0 5  1.3 12.54 0.99 0.064
  070979  0 5  1.3 12.54 0.99 0.064
  070980  0 5  1.3 12.54 0.99 0.064
  070981  0 5  1.3 12.54 0.99 0.064
  070982  0 5  1.3 12.54 0.99 0.064
  070983  0 5  1.3 12.54 0.99 0.064
     0.0       3     0.0
 Hanford fine sandy Loam; Hydrologic Group B;
  150.00           0   0   1   0   0   0   0   0   0
     0.0    0.02     0.0
```

```
   4     314
   3
   1   30.00   1.500   0.222   0.000   0.000   0.00
       0.693   0.693   0.000
         0.1   0.125   0.050   0.750    0.00
   2   60.00   1.500   0.210   0.000   0.000   0.00
       0.693   0.693   0.000
         1.0   0.120   0.050   0.200    0.00
   3   60.00   1.500   0.200   0.000   0.000   0.00
       0.693   0.693   0.000
         5.0   0.100   0.050   0.125    0.00
   0
        YEAR      10            YEAR      10            YEAR      10   1
   1
   1  -----
   7    YEAR
PRCP    TCUM   0   0
RUNF    TCUM   0   0
INFL    TCUM   1   1
ESLS    TCUM   0   0   1.0E3
RFLX    TCUM   0   0   1.0E5
EFLX    TCUM   0   0   1.0E5
RZFX    TCUM   0   0   1.0E5
```

TM On Onions output file

PRZM/EXAMS run for TM on CA onions

WATER COLUMN DISSOLVED CONCENTRATION (**PPB**)

YEAR	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
1948	50.380	26.640	6.652	2.330	1.553	0.440

1949	50.380	26.640	6.652	2.330	1.553	0.441
1950	50.380	26.640	6.652	2.330	1.553	0.441
1951	50.380	26.640	6.652	2.330	1.553	0.441
1952	50.380	26.640	6.652	2.330	1.553	0.440
1953	50.380	26.640	6.652	2.330	1.553	0.441
1954	50.380	26.640	6.652	2.330	1.553	0.441
1955	50.380	26.640	6.652	2.330	1.553	0.441
1956	50.380	26.640	6.652	2.330	1.553	0.440
1957	50.380	26.640	6.652	2.330	1.553	0.440
1958	50.380	26.640	6.648	2.328	1.552	0.441
1959	50.380	26.640	6.652	2.330	1.553	0.441
1960	50.380	26.640	6.652	2.330	1.553	0.439
1961	50.380	26.640	6.652	2.330	1.553	0.441
1962	50.380	26.640	6.652	2.330	1.553	0.440
1963	50.380	26.640	6.652	2.330	1.553	0.440
1964	50.380	26.640	6.652	2.330	1.553	0.440
1965	50.380	26.640	6.652	2.330	1.553	0.441
1966	50.380	26.640	6.652	2.330	1.553	0.441
1967	50.380	26.640	6.652	2.330	1.553	0.441
1968	50.380	26.640	6.652	2.330	1.553	0.439
1969	50.380	26.640	6.652	2.330	1.553	0.441
1970	50.380	26.640	6.652	2.330	1.553	0.441
1971	50.380	26.640	6.652	2.330	1.553	0.441
1972	50.380	26.640	6.652	2.330	1.553	0.440
1973	50.380	26.640	6.652	2.330	1.553	0.441
1974	50.380	26.640	6.652	2.330	1.553	0.440
1975	50.380	26.640	6.652	2.330	1.553	0.441
1976	50.380	26.640	6.639	2.325	1.550	0.439
1977	50.380	26.640	6.652	2.330	1.553	0.441
1978	50.380	26.640	6.652	2.330	1.553	0.441
1979	50.380	26.640	6.652	2.330	1.553	0.441
1980	50.380	26.640	6.652	2.330	1.553	0.440
1981	50.380	26.640	6.652	2.330	1.553	0.441
1982	50.380	26.640	6.652	2.330	1.553	0.441
1983	50.380	26.640	6.652	2.330	1.553	0.441

SORTED FOR PLOTTING

PROB	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
0.027	50.380	26.640	6.652	2.330	1.553	0.441
0.054	50.380	26.640	6.652	2.330	1.553	0.441

0.081	50.380	26.640	6.652	2.330	1.553	0.441
0.108	50.380	26.640	6.652	2.330	1.553	0.441
0.135	50.380	26.640	6.652	2.330	1.553	0.441
0.162	50.380	26.640	6.652	2.330	1.553	0.441
0.189	50.380	26.640	6.652	2.330	1.553	0.441
0.216	50.380	26.640	6.652	2.330	1.553	0.441
0.243	50.380	26.640	6.652	2.330	1.553	0.441
0.270	50.380	26.640	6.652	2.330	1.553	0.441
0.297	50.380	26.640	6.652	2.330	1.553	0.441
0.324	50.380	26.640	6.652	2.330	1.553	0.441
0.351	50.380	26.640	6.652	2.330	1.553	0.441
0.378	50.380	26.640	6.652	2.330	1.553	0.441
0.405	50.380	26.640	6.652	2.330	1.553	0.441
0.432	50.380	26.640	6.652	2.330	1.553	0.441
0.459	50.380	26.640	6.652	2.330	1.553	0.441
0.486	50.380	26.640	6.652	2.330	1.553	0.441
0.514	50.380	26.640	6.652	2.330	1.553	0.441
0.541	50.380	26.640	6.652	2.330	1.553	0.441
0.568	50.380	26.640	6.652	2.330	1.553	0.441
0.595	50.380	26.640	6.652	2.330	1.553	0.441
0.622	50.380	26.640	6.652	2.330	1.553	0.441
0.649	50.380	26.640	6.652	2.330	1.553	0.440
0.676	50.380	26.640	6.652	2.330	1.553	0.440
0.703	50.380	26.640	6.652	2.330	1.553	0.440
0.730	50.380	26.640	6.652	2.330	1.553	0.440
0.757	50.380	26.640	6.652	2.330	1.553	0.440
0.784	50.380	26.640	6.652	2.330	1.553	0.440
0.811	50.380	26.640	6.652	2.330	1.553	0.440
0.838	50.380	26.640	6.652	2.330	1.553	0.440
0.865	50.380	26.640	6.652	2.330	1.553	0.440
0.892	50.380	26.640	6.652	2.330	1.553	0.440
0.919	50.380	26.640	6.652	2.330	1.553	0.439
0.946	50.380	26.640	6.648	2.328	1.552	0.439
0.973	50.380	26.640	6.639	2.325	1.550	0.439
1/10	50.380	26.640	6.652	2.330	1.553	0.441

MEAN OF ANNUAL VALUES = 0.440

STANDARD DEVIATION OF ANNUAL VALUES = 0.001

UPPER 90% CONFIDENCE LIMIT ON MEAN = 0.441

MBC PRZM/EXAMS runs

MBC On peahces input file

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*** PRZM 3.1 Input File Converted from PRZM 2.3***
*** mbcpch1.INP; January 29, 1998; scenario for TM use patterns ***
*** MBC applied to peaches by aerial method***
*** Peach Co, Georgia; MLRA P133A;  Crop: Peaches***
*** Weather form MLRA P137 was used rather than P133A as Augusta was more***
*** appropriate than Birmingham for this site.***
*** Emergence date set at flower bud, maturation at beginning of harvest,
harvest at end of harvest***
*** Growth cycle information from Mark Collier, Extension Agent, Peach County,
GA***
*** Assume fair grass coverage under trees; no channel, flow is overland***
MBC
Boswell Sandy Laom; MLRA P-133A, Birmingham, Georgia, Peach
   0.750   0.150       0   17.00       1       1
       4
    0.19    3.30    1.00   10.00    5.80       3    4.00   356.8
       1
       1    0.25   17.00  100.00       1  94  78  78                0.00     600
```

```
       1       3
0110  0103  0108
0.74  0.01  0.01
0.03  0.03  0.03
      34
  010350  150550  310850   1
  010351  150551  310851   1
  010352  150552  310852   1
  010353  150553  310853   1
  010354  150554  310854   1
  010355  150555  310855   1
  010356  150556  310856   1
  010357  150557  310857   1
  010358  150558  310858   1
  010359  150559  310859   1
  010360  150560  310860   1
  010361  150561  310861   1
  010362  150562  310862   1
  010363  150563  310863   1
  010364  150564  310864   1
  010365  150565  310865   1
  010366  150566  310866   1
  010367  150567  310867   1
  010368  150568  310868   1
  010369  150569  310869   1
  010370  150570  310870   1
  010371  150571  310871   1
  010372  150572  310872   1
  010373  150573  310873   1
  010374  150574  310874   1
  010375  150575  310875   1
  010376  150576  310876   1
  010377  150577  310877   1
  010378  150578  310878   1
  010379  150579  310879   1
  010380  150580  310880   1
  010381  150581  310881   1
  010382  150582  310882   1
  010383  150583  310883   1
Application Schedule: 12 app., 0.74 lb a.i./acre, aerial Spray @ 95% eff. w/0.16
drift
     408       1       0       0
MBC: Koc 1885 (sandy loam) ASM: T1/2 = 320 day; AnSM: T1/2 = stable
  100350  0 2 0.00  0.83 0.95 0.16
  200350  0 2 0.00  0.83 0.95 0.16
  300350  0 2 0.00  0.83 0.95 0.16
  090450  0 2 0.00  0.83 0.95 0.16
  190450  0 2 0.00  0.83 0.95 0.16
  290450  0 2 0.00  0.83 0.95 0.16
  090550  0 2 0.00  0.83 0.95 0.16
  190550  0 2 0.00  0.83 0.95 0.16
  290550  0 2 0.00  0.83 0.95 0.16
  080650  0 2 0.00  0.83 0.95 0.16
  180650  0 2 0.00  0.83 0.95 0.16
  280650  0 2 0.00  0.83 0.95 0.16
  100351  0 2 0.00  0.83 0.95 0.16
  200351  0 2 0.00  0.83 0.95 0.16
```

```
300351  0 2 0.00  0.83 0.95 0.16
090451  0 2 0.00  0.83 0.95 0.16
190451  0 2 0.00  0.83 0.95 0.16
290451  0 2 0.00  0.83 0.95 0.16
090551  0 2 0.00  0.83 0.95 0.16
190551  0 2 0.00  0.83 0.95 0.16
290551  0 2 0.00  0.83 0.95 0.16
080651  0 2 0.00  0.83 0.95 0.16
180651  0 2 0.00  0.83 0.95 0.16
280651  0 2 0.00  0.83 0.95 0.16
100352  0 2 0.00  0.83 0.95 0.16
200352  0 2 0.00  0.83 0.95 0.16
300352  0 2 0.00  0.83 0.95 0.16
090452  0 2 0.00  0.83 0.95 0.16
190452  0 2 0.00  0.83 0.95 0.16
290452  0 2 0.00  0.83 0.95 0.16
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190552  0 2 0.00  0.83 0.95 0.16
290552  0 2 0.00  0.83 0.95 0.16
080652  0 2 0.00  0.83 0.95 0.16
180652  0 2 0.00  0.83 0.95 0.16
280652  0 2 0.00  0.83 0.95 0.16
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090553  0 2 0.00  0.83 0.95 0.16
190553  0 2 0.00  0.83 0.95 0.16
290553  0 2 0.00  0.83 0.95 0.16
080653  0 2 0.00  0.83 0.95 0.16
180653  0 2 0.00  0.83 0.95 0.16
280653  0 2 0.00  0.83 0.95 0.16
100354  0 2 0.00  0.83 0.95 0.16
200354  0 2 0.00  0.83 0.95 0.16
300354  0 2 0.00  0.83 0.95 0.16
090454  0 2 0.00  0.83 0.95 0.16
190454  0 2 0.00  0.83 0.95 0.16
290454  0 2 0.00  0.83 0.95 0.16
090554  0 2 0.00  0.83 0.95 0.16
190554  0 2 0.00  0.83 0.95 0.16
290554  0 2 0.00  0.83 0.95 0.16
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300355  0 2 0.00  0.83 0.95 0.16
090455  0 2 0.00  0.83 0.95 0.16
190455  0 2 0.00  0.83 0.95 0.16
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190555  0 2 0.00  0.83 0.95 0.16
290555  0 2 0.00  0.83 0.95 0.16
080655  0 2 0.00  0.83 0.95 0.16
180655  0 2 0.00  0.83 0.95 0.16
```

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300356  0 2 0.00  0.83 0.95 0.16
090456  0 2 0.00  0.83 0.95 0.16
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180658  0 2 0.00  0.83 0.95 0.16
280658  0 2 0.00  0.83 0.95 0.16
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190460  0 2 0.00  0.83 0.95 0.16
290460  0 2 0.00  0.83 0.95 0.16
090560  0 2 0.00  0.83 0.95 0.16
190560  0 2 0.00  0.83 0.95 0.16
```

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180661  0 2 0.00  0.83 0.95 0.16
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300362  0 2 0.00  0.83 0.95 0.16
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180663  0 2 0.00  0.83 0.95 0.16
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280664  0 2 0.00  0.83 0.95 0.16
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200365  0 2 0.00  0.83 0.95 0.16
300365  0 2 0.00  0.83 0.95 0.16
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190465  0 2 0.00  0.83 0.95 0.16
```

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290565  0 2 0.00  0.83 0.95 0.16
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180666  0 2 0.00  0.83 0.95 0.16
280666  0 2 0.00  0.83 0.95 0.16
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200367  0 2 0.00  0.83 0.95 0.16
300367  0 2 0.00  0.83 0.95 0.16
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190467  0 2 0.00  0.83 0.95 0.16
290467  0 2 0.00  0.83 0.95 0.16
090567  0 2 0.00  0.83 0.95 0.16
190567  0 2 0.00  0.83 0.95 0.16
290567  0 2 0.00  0.83 0.95 0.16
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180667  0 2 0.00  0.83 0.95 0.16
280667  0 2 0.00  0.83 0.95 0.16
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200368  0 2 0.00  0.83 0.95 0.16
300368  0 2 0.00  0.83 0.95 0.16
090468  0 2 0.00  0.83 0.95 0.16
190468  0 2 0.00  0.83 0.95 0.16
290468  0 2 0.00  0.83 0.95 0.16
090568  0 2 0.00  0.83 0.95 0.16
190568  0 2 0.00  0.83 0.95 0.16
290568  0 2 0.00  0.83 0.95 0.16
080668  0 2 0.00  0.83 0.95 0.16
180668  0 2 0.00  0.83 0.95 0.16
280668  0 2 0.00  0.83 0.95 0.16
100369  0 2 0.00  0.83 0.95 0.16
200369  0 2 0.00  0.83 0.95 0.16
300369  0 2 0.00  0.83 0.95 0.16
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190469  0 2 0.00  0.83 0.95 0.16
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190569  0 2 0.00  0.83 0.95 0.16
290569  0 2 0.00  0.83 0.95 0.16
080669  0 2 0.00  0.83 0.95 0.16
180669  0 2 0.00  0.83 0.95 0.16
280669  0 2 0.00  0.83 0.95 0.16
100370  0 2 0.00  0.83 0.95 0.16
200370  0 2 0.00  0.83 0.95 0.16
```

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290470  0 2 0.00  0.83 0.95 0.16
090570  0 2 0.00  0.83 0.95 0.16
190570  0 2 0.00  0.83 0.95 0.16
290570  0 2 0.00  0.83 0.95 0.16
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180670  0 2 0.00  0.83 0.95 0.16
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190571  0 2 0.00  0.83 0.95 0.16
290571  0 2 0.00  0.83 0.95 0.16
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180671  0 2 0.00  0.83 0.95 0.16
280671  0 2 0.00  0.83 0.95 0.16
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200372  0 2 0.00  0.83 0.95 0.16
300372  0 2 0.00  0.83 0.95 0.16
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180672  0 2 0.00  0.83 0.95 0.16
280672  0 2 0.00  0.83 0.95 0.16
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200373  0 2 0.00  0.83 0.95 0.16
300373  0 2 0.00  0.83 0.95 0.16
090473  0 2 0.00  0.83 0.95 0.16
190473  0 2 0.00  0.83 0.95 0.16
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180673  0 2 0.00  0.83 0.95 0.16
280673  0 2 0.00  0.83 0.95 0.16
100374  0 2 0.00  0.83 0.95 0.16
200374  0 2 0.00  0.83 0.95 0.16
300374  0 2 0.00  0.83 0.95 0.16
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090574  0 2 0.00  0.83 0.95 0.16
190574  0 2 0.00  0.83 0.95 0.16
290574  0 2 0.00  0.83 0.95 0.16
080674  0 2 0.00  0.83 0.95 0.16
180674  0 2 0.00  0.83 0.95 0.16
```

```
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300375  0 2 0.00  0.83 0.95 0.16
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190479  0 2 0.00  0.83 0.95 0.16
290479  0 2 0.00  0.83 0.95 0.16
090579  0 2 0.00  0.83 0.95 0.16
190579  0 2 0.00  0.83 0.95 0.16
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  190580  0 2 0.00  0.83 0.95 0.16
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  300381  0 2 0.00  0.83 0.95 0.16
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  190481  0 2 0.00  0.83 0.95 0.16
  290481  0 2 0.00  0.83 0.95 0.16
  090581  0 2 0.00  0.83 0.95 0.16
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  100382  0 2 0.00  0.83 0.95 0.16
  200382  0 2 0.00  0.83 0.95 0.16
  300382  0 2 0.00  0.83 0.95 0.16
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  190482  0 2 0.00  0.83 0.95 0.16
  290482  0 2 0.00  0.83 0.95 0.16
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  100383  0 2 0.00  0.83 0.95 0.16
  200383  0 2 0.00  0.83 0.95 0.16
  300383  0 2 0.00  0.83 0.95 0.16
  090483  0 2 0.00  0.83 0.95 0.16
  190483  0 2 0.00  0.83 0.95 0.16
  290483  0 2 0.00  0.83 0.95 0.16
  090583  0 2 0.00  0.83 0.95 0.16
  190583  0 2 0.00  0.83 0.95 0.16
  290583  0 2 0.00  0.83 0.95 0.16
  080683  0 2 0.00  0.83 0.95 0.16
  180683  0 2 0.00  0.83 0.95 0.16
  280683  0 2 0.00  0.83 0.95 0.16
    0.00       3    0.00
    0.00    0.02    0.50
Boswell sandy loam; Hydrologic Group D
     100           0   0   1   0   0   0   0   0   0
     0.0    0.00    0.00
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          0.1   0.213   0.063   0.800    16.3
    2   11.80   1.700   0.213   0.000   0.000
        0.002   0.002   0.000
          0.1   0.213   0.063   0.800    16.3
    3   88.00   1.700   0.354   0.000   0.000
        0.002   0.002   0.000
            2   0.354   0.213   0.800    16.3
    0
         YEAR       5            YEAR       5            YEAR       5   1
    1
    1  -----
    6    YEAR
 PRCP    TCUM   0   0
 RUNF    TCUM   0   0
 ESLS    TCUM   0   0   1.0E3
 RFLX    TCUM   0   0   1.0E5
 EFLX    TCUM   0   0   1.0E5
 RZFX    TCUM   0   0   1.0E5
```

MBC On peahces output file

MBC (FROM TM) ON GA PEACHES

WATER COLUMN DISSOLVED CONCENTRATION (**PPB**)

YEAR	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
1950	65.850	61.000	51.440	37.110	34.400	20.920
1951	43.010	41.380	39.420	38.870	38.130	30.890
1952	65.780	62.570	53.190	47.830	46.530	36.170
1953	52.690	50.740	48.060	46.900	45.520	37.380
1954	58.440	56.120	50.330	49.630	48.840	39.130
1955	64.840	62.230	59.010	55.700	54.230	40.650
1956	61.710	58.970	51.330	50.330	50.050	41.540
1957	62.230	60.110	57.930	55.280	52.980	45.700
1958	59.600	57.980	55.410	54.480	53.650	43.690
1959	54.530	52.830	50.710	49.930	49.330	42.570
1960	62.290	60.050	57.590	54.870	54.780	42.340
1961	68.430	66.220	61.290	58.190	56.400	42.910
1962	66.420	63.930	60.000	55.930	55.200	45.630
1963	61.450	59.500	56.140	54.930	53.970	44.930
1964	85.140	81.500	74.590	69.480	68.310	55.380

1965	69.020	66.540	63.940	59.400	58.180	47.890
1966	75.360	72.350	66.420	59.910	57.000	44.730
1967	92.290	87.910	79.020	71.550	66.370	49.060
1968	66.730	64.890	59.750	56.540	54.050	44.500
1969	60.580	58.600	55.770	55.050	54.200	44.600
1970	67.890	64.830	56.150	51.680	51.240	44.180
1971	67.600	65.120	60.440	58.380	56.840	45.850
1972	72.800	69.540	62.900	53.980	51.920	41.810
1973	74.170	71.080	68.050	59.180	57.340	45.330
1974	56.270	54.610	52.500	52.040	51.770	42.870
1975	70.730	67.310	57.250	52.170	51.230	44.440
1976	62.050	59.990	56.680	54.910	53.210	46.090
1977	60.290	58.670	56.750	56.040	55.670	45.870
1978	75.690	71.710	62.230	50.760	49.790	44.540
1979	85.710	81.810	69.780	64.930	64.600	54.130
1980	72.610	70.000	66.790	60.580	60.070	51.030
1981	102.000	98.790	91.430	75.580	68.690	52.530
1982	73.110	70.240	63.120	59.070	58.050	48.630
1983	68.310	65.770	61.040	57.890	57.810	50.240

SORTED FOR PLOTTING

PROB	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
0.029	102.000	98.790	91.430	75.580	68.690	55.380
0.057	92.290	87.910	79.020	71.550	68.310	54.130
0.086	85.710	81.810	74.590	69.480	66.370	52.530
0.114	85.140	81.500	69.780	64.930	64.600	51.030
0.143	75.690	72.350	68.050	60.580	60.070	50.240
0.171	75.360	71.710	66.790	59.910	58.180	49.060
0.200	74.170	71.080	66.420	59.400	58.050	48.630
0.229	73.110	70.240	63.940	59.180	57.810	47.890
0.257	72.800	70.000	63.120	59.070	57.340	46.090
0.286	72.610	69.540	62.900	58.380	57.000	45.870
0.314	70.730	67.310	62.230	58.190	56.840	45.850
0.343	69.020	66.540	61.290	57.890	56.400	45.700
0.371	68.430	66.220	61.040	56.540	55.670	45.630
0.400	68.310	65.770	60.440	56.040	55.200	45.330
0.429	67.890	65.120	60.000	55.930	54.780	44.930
0.457	67.600	64.890	59.750	55.700	54.230	44.730
0.486	66.730	64.830	59.010	55.280	54.200	44.600
0.514	66.420	63.930	57.930	55.050	54.050	44.540

0.543	65.850	62.570	57.590	54.930	53.970	44.500
0.571	65.780	62.230	57.250	54.910	53.650	44.440
0.600	64.840	61.000	56.750	54.870	53.210	44.180
0.629	62.290	60.110	56.680	54.480	52.980	43.690
0.657	62.230	60.050	56.150	53.980	51.920	42.910
0.686	62.050	59.990	56.140	52.170	51.770	42.870
0.714	61.710	59.500	55.770	52.040	51.240	42.570
0.743	61.450	58.970	55.410	51.680	51.230	42.340
0.771	60.580	58.670	53.190	50.760	50.050	41.810
0.800	60.290	58.600	52.500	50.330	49.790	41.540
0.829	59.600	57.980	51.440	49.930	49.330	40.650
0.857	58.440	56.120	51.330	49.630	48.840	39.130
0.886	56.270	54.610	50.710	47.830	46.530	37.380
0.914	54.530	52.830	50.330	46.900	45.520	36.170
0.943	52.690	50.740	48.060	38.870	38.130	30.890
0.971	43.010	41.380	39.420	37.110	34.400	20.920
1/10	85.425	81.655	72.185	67.205	65.485	51.780

MEAN OF ANNUAL VALUES = 44.063

STANDARD DEVIATION OF ANNUAL VALUES = 6.370

UPPER 90% CONFIDENCE LIMIT ON MEAN = 45.682

MBC On Soybeans input file

```
MBC (from TM)
Location: MLRA: P-133A; Georgia
   0.750   0.150       0   17.00       1       3
       4
    0.42    1.00    1.00    10.0               3    2.00   354.0
       1
       1    0.20   22.00  100.00       3  91  85  88                0.00   80.00
       1       3
0101 0107 0109
0.50 0.50 0.50
.023 .023 .023
      36
   1 748  171048   11148   1
   1 749  171049   11149   1
   1 750  171050   11150   1
   1 751  171051   11151   1
   1 752  171052   11152   1
```

```
   1 753  171053   11153   1
   1 754  171054   11154   1
   1 755  171055   11155   1
   1 756  171056   11156   1
   1 757  171057   11157   1
   1 758  171058   11158   1
   1 759  171059   11159   1
   1 760  171060   11160   1
   1 761  171061   11161   1
   1 762  171062   11162   1
   1 763  171063   11163   1
   1 764  171064   11164   1
   1 765  171065   11165   1
   1 766  171066   11166   1
   1 767  171067   11167   1
   1 768  171068   11168   1
   1 769  171069   11169   1
   1 770  171070   11170   1
   1 771  171071   11171   1
   1 772  171072   11172   1
   1 773  171073   11173   1
   1 774  171074   11174   1
   1 775  171075   11175   1
   1 776  171076   11176   1
   1 777  171077   11177   1
   1 778  171078   11178   1
   1 779  171079   11179   1
   1 780  171080   11180   1
   1 781  171081   11181   1
   1 782  171082   11182   1
   1 783  171083   11183   1
Application Schedule: 2 aerial appl. (4-day interval) @0.49 lb ai/acre.
      72       1       0       0
MBC  KOC:1885   ; AESM T1/2=
  080848  0 2 0.00  0.55 0.95 0.16
  120848  0 2 0.00  0.55 0.95 0.16
  080849  0 2 0.00  0.55 0.95 0.16
  120849  0 2 0.00  0.55 0.95 0.16
  080850  0 2 0.00  0.55 0.95 0.16
  120850  0 2 0.00  0.55 0.95 0.16
  080851  0 2 0.00  0.55 0.95 0.16
  120851  0 2 0.00  0.55 0.95 0.16
  080852  0 2 0.00  0.55 0.95 0.16
  120852  0 2 0.00  0.55 0.95 0.16
  080853  0 2 0.00  0.55 0.95 0.16
  120853  0 2 0.00  0.55 0.95 0.16
  080854  0 2 0.00  0.55 0.95 0.16
  120854  0 2 0.00  0.55 0.95 0.16
  080855  0 2 0.00  0.55 0.95 0.16
  120855  0 2 0.00  0.55 0.95 0.16
  080856  0 2 0.00  0.55 0.95 0.16
  120856  0 2 0.00  0.55 0.95 0.16
  080857  0 2 0.00  0.55 0.95 0.16
  120857  0 2 0.00  0.55 0.95 0.16
  080858  0 2 0.00  0.55 0.95 0.16
  120858  0 2 0.00  0.55 0.95 0.16
  080859  0 2 0.00  0.55 0.95 0.16
```

```
  120859  0 2 0.00  0.55 0.95 0.16
  080860  0 2 0.00  0.55 0.95 0.16
  120860  0 2 0.00  0.55 0.95 0.16
  080861  0 2 0.00  0.55 0.95 0.16
  120861  0 2 0.00  0.55 0.95 0.16
  080862  0 2 0.00  0.55 0.95 0.16
  120862  0 2 0.00  0.55 0.95 0.16
  080863  0 2 0.00  0.55 0.95 0.16
  120863  0 2 0.00  0.55 0.95 0.16
  080864  0 2 0.00  0.55 0.95 0.16
  120864  0 2 0.00  0.55 0.95 0.16
  080865  0 2 0.00  0.55 0.95 0.16
  120865  0 2 0.00  0.55 0.95 0.16
  080866  0 2 0.00  0.55 0.95 0.16
  120866  0 2 0.00  0.55 0.95 0.16
  080867  0 2 0.00  0.55 0.95 0.16
  120867  0 2 0.00  0.55 0.95 0.16
  080868  0 2 0.00  0.55 0.95 0.16
  120868  0 2 0.00  0.55 0.95 0.16
  080869  0 2 0.00  0.55 0.95 0.16
  120869  0 2 0.00  0.55 0.95 0.16
  080870  0 2 0.00  0.55 0.95 0.16
  120870  0 2 0.00  0.55 0.95 0.16
  080871  0 2 0.00  0.55 0.95 0.16
  120871  0 2 0.00  0.55 0.95 0.16
  080872  0 2 0.00  0.55 0.95 0.16
  120872  0 2 0.00  0.55 0.95 0.16
  080873  0 2 0.00  0.55 0.95 0.16
  120873  0 2 0.00  0.55 0.95 0.16
  080874  0 2 0.00  0.55 0.95 0.16
  120874  0 2 0.00  0.55 0.95 0.16
  080875  0 2 0.00  0.55 0.95 0.16
  120875  0 2 0.00  0.55 0.95 0.16
  080876  0 2 0.00  0.55 0.95 0.16
  120876  0 2 0.00  0.55 0.95 0.16
  080877  0 2 0.00  0.55 0.95 0.16
  120877  0 2 0.00  0.55 0.95 0.16
  080878  0 2 0.00  0.55 0.95 0.16
  120878  0 2 0.00  0.55 0.95 0.16
  080879  0 2 0.00  0.55 0.95 0.16
  120879  0 2 0.00  0.55 0.95 0.16
  080880  0 2 0.00  0.55 0.95 0.16
  120880  0 2 0.00  0.55 0.95 0.16
  080881  0 2 0.00  0.55 0.95 0.16
  120881  0 2 0.00  0.55 0.95 0.16
  080882  0 2 0.00  0.55 0.95 0.16
  120882  0 2 0.00  0.55 0.95 0.16
  080883  0 2 0.00  0.55 0.95 0.16
  120883  0 2 0.00  0.55 0.95 0.16
     0.0       3     0.0
    0.00   0.000     0.5
LYNCHBERG LOAMY SAND; HYDROLOGIC GROUP C
  100.00           0   0   1   0   0   0   0   0   0
     0.0     0.0     0.0
       4    1885
       2
       1   26.00   1.700   0.140   0.000   0.000   0.000
```

```
          0.002   0.002   0.000
          0.100   0.104   0.034   2.900   0.00
      2   74.00   1.500   0.232   0.000   0.000   0.000
          0.002   0.002   0.000
          1.000   0.232   0.112   0.174   0.000
      0
           YEAR       5            YEAR       5            YEAR       5   1
      1
      1  -----
      6    YEAR
   PRCP    TCUM   0   0
   RUNF    TCUM   0   0
   ESLS    TCUM   0   0   1.0E3
   RFLX    TCUM   0   0   1.0E5
   EFLX    TCUM   0   0   1.0E5
   RZFX    TCUM   0   0   1.0E5
```

MBC On Soybeans output file

PRZM/EXAMS Run for MBC (from TM) on GA Soybeans

WATER COLUMN DISSOLVED CONCENTRATION (PPB)

YEAR	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
1948	11.650	10.990	9.312	6.369	5.098	2.091
1949	11.040	10.270	8.219	6.192	5.592	4.798
1950	13.840	13.090	11.230	10.390	9.654	5.912
1951	12.380	11.600	9.759	8.573	8.397	7.108
1952	12.650	11.830	9.604	7.350	6.947	6.077
1953	18.960	17.760	14.500	11.350	10.870	7.025
1954	12.850	12.060	9.936	8.847	8.693	7.064
1955	11.920	11.150	9.041	6.984	6.709	5.823
1956	14.890	13.980	12.410	9.896	9.139	6.031
1957	12.930	12.150	10.920	9.992	9.509	8.123
1958	12.890	12.110	9.978	8.785	8.508	7.329
1959	11.560	10.790	8.697	7.417	7.331	6.096
1960	13.210	12.360	10.030	8.270	7.786	6.334
1961	17.190	16.240	13.500	11.020	10.180	7.854
1962	15.450	14.620	12.220	9.822	9.550	8.450
1963	12.540	11.880	9.875	8.366	8.168	7.422
1964	13.370	12.550	11.270	10.520	10.160	8.373
1965	14.200	13.350	11.060	10.210	9.984	8.501

1966	12.380	11.610	9.495	9.123	9.023	7.659
1967	12.560	11.780	9.763	8.470	8.060	7.248
1968	11.780	11.010	8.911	7.048	6.877	6.082
1969	11.580	10.990	9.471	8.089	7.853	6.194
1970	11.970	11.180	9.069	7.047	6.564	5.804
1971	12.800	12.130	10.380	9.081	8.412	6.181
1972	12.380	11.580	10.030	7.974	7.392	6.542
1973	12.170	11.380	9.251	7.324	6.888	6.242
1974	12.620	11.760	10.130	9.284	8.835	6.280
1975	13.370	12.740	11.480	10.020	9.577	7.812
1976	12.580	11.810	9.697	8.582	8.132	7.310
1977	12.360	11.560	9.415	8.121	7.666	6.692
1978	14.630	13.680	11.180	8.573	7.806	6.678
1979	12.570	11.790	9.672	7.935	7.837	7.016
1980	11.720	10.950	8.850	6.977	6.691	5.929
1981	12.210	11.410	9.346	7.357	6.756	5.917
1982	16.320	15.270	12.440	10.290	9.469	7.447
1983	13.450	12.660	10.600	9.883	9.643	8.596

SORTED FOR PLOTTING

PROB	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
0.027	18.960	17.760	14.500	11.350	10.870	8.596
0.054	17.190	16.240	13.500	11.020	10.180	8.501
0.081	16.320	15.270	12.440	10.520	10.160	8.450
0.108	15.450	14.620	12.410	10.390	9.984	8.373
0.135	14.890	13.980	12.220	10.290	9.654	8.123
0.162	14.630	13.680	11.480	10.210	9.643	7.854
0.189	14.200	13.350	11.270	10.020	9.577	7.812
0.216	13.840	13.090	11.230	9.992	9.550	7.659
0.243	13.450	12.740	11.180	9.896	9.509	7.447
0.270	13.370	12.660	11.060	9.883	9.469	7.422
0.297	13.370	12.550	10.920	9.822	9.139	7.329
0.324	13.210	12.360	10.600	9.284	9.023	7.310
0.351	12.930	12.150	10.380	9.123	8.835	7.248
0.378	12.890	12.130	10.130	9.081	8.693	7.108
0.405	12.850	12.110	10.030	8.847	8.508	7.064
0.432	12.800	12.060	10.030	8.785	8.412	7.025
0.459	12.650	11.880	9.978	8.582	8.397	7.016
0.486	12.620	11.830	9.936	8.573	8.168	6.692
0.514	12.580	11.810	9.875	8.573	8.132	6.678

0.541	12.570	11.790	9.763	8.470	8.060	6.542
0.568	12.560	11.780	9.759	8.366	7.853	6.334
0.595	12.540	11.760	9.697	8.270	7.837	6.280
0.622	12.380	11.610	9.672	8.121	7.806	6.242
0.649	12.380	11.600	9.604	8.089	7.786	6.194
0.676	12.380	11.580	9.495	7.974	7.666	6.181
0.703	12.360	11.560	9.471	7.935	7.392	6.096
0.730	12.210	11.410	9.415	7.417	7.331	6.082
0.757	12.170	11.380	9.346	7.357	6.947	6.077
0.784	11.970	11.180	9.312	7.350	6.888	6.031
0.811	11.920	11.150	9.251	7.324	6.877	5.929
0.838	11.780	11.010	9.069	7.048	6.756	5.917
0.865	11.720	10.990	9.041	7.047	6.709	5.912
0.892	11.650	10.990	8.911	6.984	6.691	5.823
0.919	11.580	10.950	8.850	6.977	6.564	5.804
0.946	11.560	10.790	8.697	6.369	5.592	4.798
0.973	11.040	10.270	8.219	6.192	5.098	2.091
1/10	15.711	14.815	12.419	10.429	10.037	8.396

MEAN OF ANNUAL VALUES = 6.723

STANDARD DEVIATION OF ANNUAL VALUES = 1.216

UPPER 90% CONFIDENCE LIMIT ON MEAN = 7.023

MBC On Onions input file

```
*** PRZM 3.12 Input Data File converted from PRZM 2.3
*** Converted from Grape scenario to Onion ********
*** MBCCaOn.INP, created 2 July 1999; Stanislaus county, CA.***
*** Soil Hanford, Hydrologic Group B ***
*** Assume poor grass coverage under vines and overland flow***
*** Pesticide is ground spray applied in furrows***
*** This is intended to use a modified metfile, incorporating irrigation ***
*** cropping curve number reduced from 78 to fit the 15% of flood irrigation ***
*** water which runs off. The 15% number comes from Terry Pritchard, ***
*** San Joachin county cooperative extension, (209) 468-2085 ***
MBC
Hanford fine sandyloam; MLRA L-17, Stanislaus County, CA.
   0.852   0.450       0   15.00       1       3
       4
    0.34    0.15    1.00     172    5.80       3   0.500   464.0
       1
       1    0.25   90.00  100.00       3  86  59  82                0.00    35.0
       1       3
```

```
0101 0110 0111
0.05 0.05 0.05
.023 .023 .023
      36
  060948  150449  010549       1
  070949  150450  010550       1
  070950  150451  010551       1
  070951  150452  010552       1
  070952  150453  010553       1
  070953  150454  010554       1
  070954  150455  010555       1
  070955  150456  010556       1
  070956  150457  010557       1
  070957  150458  010558       1
  070958  150459  010559       1
  070959  150460  010560       1
  070960  150461  010561       1
  070961  150462  010562       1
  070962  150463  010563       1
  070963  150464  010564       1
  070964  150465  010565       1
  070965  150466  010566       1
  070966  150467  010567       1
  070967  150468  010568       1
  070968  150469  010569       1
  070969  150470  010570       1
  070970  150471  010571       1
  070971  150472  010572       1
  070972  150473  010573       1
  070973  150474  010574       1
  070974  150475  010575       1
  070975  150476  010576       1
  070976  150477  010577       1
  070977  150478  010578       1
  070978  150479  010579       1
  070979  150480  010580       1
  070980  150481  010581       1
  070981  150482  010582       1
  070982  150483  010583       1
  070983  150484  010584       1
Application Schedule: 1 ground spray app, 5.2 lb a.i./acre, 99% effic., 0.064
DRFt.
      36       1       0       0
Koc 1885; ASM: T1/2 = 320 days; AnSM: T1/2 =  days
  070948  0 5  1.3 5.81 0.99 0.064
  070949  0 5  1.3 5.81 0.99 0.064
  070950  0 5  1.3 5.81 0.99 0.064
  070951  0 5  1.3 5.81 0.99 0.064
  070952  0 5  1.3 5.81 0.99 0.064
  070953  0 5  1.3 5.81 0.99 0.064
  070954  0 5  1.3 5.81 0.99 0.064
  070955  0 5  1.3 5.81 0.99 0.064
  070956  0 5  1.3 5.81 0.99 0.064
  070957  0 5  1.3 5.81 0.99 0.064
  070958  0 5  1.3 5.81 0.99 0.064
  070959  0 5  1.3 5.81 0.99 0.064
  070960  0 5  1.3 5.81 0.99 0.064
```

```
 070961  0 5  1.3 5.81 0.99 0.064
 070962  0 5  1.3 5.81 0.99 0.064
 070963  0 5  1.3 5.81 0.99 0.064
 070964  0 5  1.3 5.81 0.99 0.064
 070965  0 5  1.3 5.81 0.99 0.064
 070966  0 5  1.3 5.81 0.99 0.064
 070967  0 5  1.3 5.81 0.99 0.064
 070968  0 5  1.3 5.81 0.99 0.064
 070969  0 5  1.3 5.81 0.99 0.064
 070970  0 5  1.3 5.81 0.99 0.064
 070971  0 5  1.3 5.81 0.99 0.064
 070972  0 5  1.3 5.81 0.99 0.064
 070973  0 5  1.3 5.81 0.99 0.064
 070974  0 5  1.3 5.81 0.99 0.064
 070975  0 5  1.3 5.81 0.99 0.064
 070976  0 5  1.3 5.81 0.99 0.064
 070977  0 5  1.3 5.81 0.99 0.064
 070978  0 5  1.3 5.81 0.99 0.064
 070979  0 5  1.3 5.81 0.99 0.064
 070980  0 5  1.3 5.81 0.99 0.064
 070981  0 5  1.3 5.81 0.99 0.064
 070982  0 5  1.3 5.81 0.99 0.064
 070983  0 5  1.3 5.81 0.99 0.064
    0.0       3    0.0
Hanford fine sandy Loam; Hydrologic Group B;
 150.00           0   0   1   0   0   0   0   0   0
    0.0     0.0     0.0
      4    1885
      3
      1   30.00   1.500   0.222   0.000   0.000   0.00
          0.002   0.002   0.000
            0.1   0.125   0.050   0.750    0.00
      2   60.00   1.500   0.210   0.000   0.000   0.00
          0.002   0.002   0.000
            1.0   0.120   0.050   0.200    0.00
      3   60.00   1.500   0.200   0.000   0.000   0.00
          0.002   0.002   0.000
            5.0   0.100   0.050   0.125    0.00
      0
           YEAR      10            YEAR      10            YEAR      10   1
      1
      1  -----
      7    YEAR
   PRCP    TCUM   0   0
   RUNF    TCUM   0   0
   INFL    TCUM   1   1
   ESLS    TCUM   0   0   1.0E3
   RFLX    TCUM   0   0   1.0E5
   EFLX    TCUM   0   0   1.0E5
   RZFX    TCUM   0   0   1.0E5
```

MBC On Onions output file

PRZM/EXAMS run for MBC (from TM) on CA onions

WATER COLUMN DISSOLVED CONCENTRATION (**PPB**)

YEAR	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
1948	89.050	81.330	58.870	38.300	32.230	9.340
1949	130.000	122.000	98.760	77.760	71.370	62.050
1950	132.000	124.000	100.000	79.260	72.890	66.120
1951	136.000	128.000	105.000	85.020	79.340	70.890
1952	206.000	196.000	163.000	128.000	115.000	84.280
1953	189.000	180.000	152.000	121.000	110.000	86.940
1954	138.000	130.000	107.000	87.240	82.060	75.240
1955	144.000	136.000	112.000	98.770	91.920	80.340
1956	143.000	135.000	112.000	93.700	88.540	79.960
1957	138.000	130.000	107.000	86.350	79.990	74.900
1958	128.000	120.000	97.400	82.910	77.880	66.160
1959	141.000	133.000	109.000	90.460	86.100	74.390
1960	161.000	154.000	132.000	108.000	99.330	87.290
1961	131.000	123.000	99.530	78.560	72.210	64.550
1962	128.000	120.000	96.410	76.760	71.140	63.120
1963	134.000	126.000	102.000	81.410	75.030	68.420
1964	136.000	128.000	105.000	83.490	77.050	70.040
1965	215.000	203.000	169.000	132.000	119.000	91.880
1966	214.000	204.000	171.000	136.000	124.000	95.990
1967	134.000	126.000	103.000	88.400	83.780	72.390
1968	131.000	123.000	99.350	84.370	77.680	67.080
1969	147.000	141.000	121.000	99.470	91.390	71.130
1970	137.000	129.000	106.000	84.770	79.000	71.980
1971	135.000	127.000	109.000	92.180	85.470	73.220
1972	214.000	203.000	168.000	131.000	118.000	102.000
1973	135.000	127.000	104.000	94.180	89.570	74.370
1974	137.000	129.000	107.000	90.130	83.540	74.590
1975	128.000	120.000	96.830	75.870	70.150	62.820
1976	131.000	123.000	109.000	93.390	85.430	72.000
1977	140.000	132.000	110.000	93.990	87.530	78.240
1978	200.000	190.000	160.000	133.000	122.000	87.700
1979	161.000	154.000	132.000	108.000	99.530	81.910
1980	135.000	127.000	103.000	86.680	81.430	71.840
1981	135.000	127.000	107.000	87.980	80.860	72.330
1982	137.000	129.000	111.000	93.260	86.520	75.320
1983	126.000	118.000	102.000	84.600	76.740	65.030

SORTED FOR PLOTTING

PROB	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
0.027	215.000	204.000	171.000	136.000	124.000	102.000
0.054	214.000	203.000	169.000	133.000	122.000	95.990
0.081	214.000	203.000	168.000	132.000	119.000	91.880
0.108	206.000	196.000	163.000	131.000	118.000	87.700
0.135	200.000	190.000	160.000	128.000	115.000	87.290
0.162	189.000	180.000	152.000	121.000	110.000	86.940
0.189	161.000	154.000	132.000	108.000	99.530	84.280
0.216	161.000	154.000	132.000	108.000	99.330	81.910
0.243	147.000	141.000	121.000	99.470	91.920	80.340
0.270	144.000	136.000	112.000	98.770	91.390	79.960
0.297	143.000	135.000	112.000	94.180	89.570	78.240
0.324	141.000	133.000	111.000	93.990	88.540	75.320
0.351	140.000	132.000	110.000	93.700	87.530	75.240
0.378	138.000	130.000	109.000	93.390	86.520	74.900
0.405	138.000	130.000	109.000	93.260	86.100	74.590
0.432	137.000	129.000	109.000	92.180	85.470	74.390
0.459	137.000	129.000	107.000	90.460	85.430	74.370
0.486	137.000	129.000	107.000	90.130	83.780	73.220
0.514	136.000	128.000	107.000	88.400	83.540	72.390
0.541	136.000	128.000	107.000	87.980	82.060	72.330
0.568	135.000	127.000	106.000	87.240	81.430	72.000
0.595	135.000	127.000	105.000	86.680	80.860	71.980
0.622	135.000	127.000	105.000	86.350	79.990	71.840
0.649	135.000	127.000	104.000	85.020	79.340	71.130
0.676	134.000	126.000	103.000	84.770	79.000	70.890
0.703	134.000	126.000	103.000	84.600	77.880	70.040
0.730	132.000	124.000	102.000	84.370	77.680	68.420
0.757	131.000	123.000	102.000	83.490	77.050	67.080
0.784	131.000	123.000	100.000	82.910	76.740	66.160
0.811	131.000	123.000	99.530	81.410	75.030	66.120
0.838	130.000	122.000	99.350	79.260	72.890	65.030
0.865	128.000	120.000	98.760	78.560	72.210	64.550
0.892	128.000	120.000	97.400	77.760	71.370	63.120
0.919	128.000	120.000	96.830	76.760	71.140	62.820
0.946	126.000	118.000	96.410	75.870	70.150	62.050
0.973	89.050	81.330	58.870	38.300	32.230	9.340
1/10	208.400	198.100	164.500	131.300	118.300	88.954

MEAN OF ANNUAL VALUES = 73.496

STANDARD DEVIATION OF ANNUAL VALUES = 14.509

UPPER 90% CONFIDENCE LIMIT ON MEAN = 77.077

APPENDIX 5: ENVIRONMENTAL FATE REVIEWS FOR TM

Date Out: **Chemical Code: 102001**
DPBarcode:180616,230325,250671,209863,167185,172035,230126,212326,179584

To: **Susan Lewis**
John Newland
Special Review and Registration Division (7507C)
From: **Ibrahim Saheb, Agronomist**
Environmental Fate & Monitoring Branch/EFED (7507C)

Thru: **Betsy Behl, Chief**
Environmental Fate & Monitoring Branch/EFED (7507C)
Attached, please find the EFED review of...

Common Name:	**Thiophanate-methyl**	**Trade name:**	**Topsin M, Fungo Cercobin M, NF-44**
Company Name:	**Atochem North America.**		
ID #:	**102001**		
Purpose:	**To review Guide line 163-2, laboratory Volatility study to support the reregistration of thiophanate-methyl.**		

Type Product:	**Action Code:**	**EFED #(s):**	**Review Time:**

Fungicide/Insecticide			

STATUS OF STUDIES REQUIREMENTS

Guideline #	MRID	Status[1]
161-1	40095507	A
161-2	41482806	A
161-3	42094601	A
162-1	00106085	A
162-3	40061501	A
163-1	42351001	A
163-2	42380101	U
164-1A	41930101	A
164-1B	41930102	A
164-1C	43433701	A

STATUS OF DATA

Guideline #	status[2]
161-1	S
161-2	S
161-3	S
162-1	S
162-3	S
163-1	S
163-2	N
164-1A	S
164-1B	S
164-1C	S

1Study Status Codes: A=Acceptable U=Upgradeable C=Ancillary I=Invalid.
2Data Requirement Status Codes: S=Satisfied P=Partially satisfied N=Not satisfied R=Reserved W=Waived.

CHEMICAL:

***Common Name: Thiophanate Methyl**
***Trade Name: TOPSIN**
***Chemical Name: dimethyl [(1,2-phenylene)bis-(iminocarobnothioyl))biscarbamate**
***Type of Product: Fungicide**
***Chemical Structure:**
***Physical and Chemical Properties:**

Molecular weight: 342.4
Boiling Point (at 20 ºC): 168 ºC
Aqueous Solubility (mg/L at 25 ºC): 21.8
Vapor Pressure: $1.30X10^{-5}$ mmHg.
Henry's Law Constant: $2.69X10^{-7}$ atm-m^3/mol (calculated).
Pka (at 25 ºC): 7.8
K_{ow}: 1.38
K_{oc}: 314 cm^3/g.

EXECUTIVE SUMMARY: ENVIRONMENTAL FATE, SURFACE AND GROUND WATER ASSESSMENT

Thiophanate-methyl,((1,2-phenylene)bis(iminocarbonothioyl)) bis(carbamate):

Based upon data from acceptable studies Thiophanate-methyl is rapidly (less than 1 day) converted to MBC (Methyl 2-benzimidazolylcarbamate). Therefore under most conditions parent Thiophanate-methyl per se would not likely to be found in ground water as it is rapidly degraded to MBC. There may be some concern for contamination of surface water through erosion of soil particles or runoff containing the parent compound, but this is only a short term threat due to the rapid conversion to MBC in soils as well as rapid conversion to MBC

through photodegradation.

MBC, ((Methyl 1H-benzimidazol-2yl-carbamate):

EFED has a substantial data base on MBC due to the compound being registered for use through another registrant. These studies include:

ACC. 00151418, (DuPont), Hydrolysis study;
ACC. 00151419, (DuPont), Aqueous Photolysis;
ACC. 00151420, (DuPont), Soil Photolysis;
MRID 41255801, (DuPont), Aerobic Soil Metabolism;
ACC. 00151421, (DuPont), Leaching/Adsorption/Desorption;
ACC. 00151422, (DuPont), Leaching/Adsorption/Desorption;
MRID 41274801, (DuPont), Field Dissipation;
ACC. 00146415, (DuPont), Field Dissipation.

MBC is a very persistent chemical, but is immobile in sandy loam and silt loam soils and will likely remain in the upper soil profile of these and similar soils. Leaching to groundwater in highly sandy soils with low organic matter can not be ruled out.

MBC the major degradate of Thiophanate-methyl is stable to hydrolysis at pH's 5, 7 and 9, and was stable under those test conditions in the aqueous and soil photolysis studies. MBC appeared to degrade very slowly in the aerobic soil metabolism studies with a half-life of 320 days. However, the metabolism studies indicate that MBC would not have a high potential to move to ground water as it binds irreversibly to soils mineral fraction over time. Acceptable mobility studies (soil column leaching) also indicate that MBC and its residues were immobile in two silt loams (Flanagan 4.3% OM, and Keyport 7.5% OM) and two sandy loam (Cecil 2.1% OM and Woodston 1.1% OM) soils. The field studies support this conclusion demonstrating that MBC (applied to turf) did not move below the 15 cm soil layer; the majority of the residues (>95%) were found in the top 10 cm soil layer. MBC may pose a concern to surface water by erosion of soil particles to which MBC is adsorbed.

Based on the moderately low vapor pressure of Thiophanate-methyl and MBC, volatilization from soils will not be an important dissipation mechanism. The low octanol/water coefficient and bioaccumulation studies suggests that parent Thiophanate-methyl and MBC will have a low tendency to accumulate in fish.

<u>The submission of data required for the registration of Thiophanate Methyl (TM) is summarized below:</u>

<u>Satisfied</u>:
-Hydrolysis (161-1) MRID #40095507: Hydrolytic stability of thiophanate-methyl decreases with increasing pH and temperature. Thiophanate-methyl was stable at pH 5 and hydrolyzed with half-lives of 36 and 0.7 days at pH 7 and pH 9, respectively. The main degradates found at variable amounts throughout the duration of the experiment were:
Methyl 2-benzimidazolylcarbamate ("MBC") and Methyl N-[2-(thioureido)phenylaminocarbonothioyl]carbamate ("AV-1951") The amount of these degradates increased with time. MBC was always found at higher concentrations than AV-1951 at all sampling intervals. At pH 7, 2.86 ppm of MBC and 0.81 ppm of AV-1951 were present after 96 hours. The original thiophanate-methyl concentration was 10 ppm.

-Photodegradation in Water (161-2) MRID #41482806: The calculated half-life for the photodegradation of thiophanate-methyl in a pH 5 buffer system was 2.17 days (natural sunlight). The degradates MBC and methyl

N-[2-(N`-methoxycarbonylthio-ureido)phenylaminocarbonyl]-carbamate ("DX-105") reached a maximum of 49.7% and 14.3% of the applied, respectively at 5.5 days. These degradates were found in very small amounts in the dark control samples (90.8% remained as parent after 5.5days). The degradate dimethyl [(phenylene)bis(iminocarbonyl)]bis(carbamate), ("FH-432") was unique to the irradiated samples and its concentration was 4.4% of applied after 5.5 days. From quantum yield calculations with chemical actinometer the half-life would be 0.53 days for summer, 0.66 days for spring, and 2.48 days for winter.

-Photodegradation on Soil (161-3) MRID #42094601: In natural sunlight the reported half-life was 2.9-5.5 days (as compared to 10.3-19.3 days for dark conditions) in a sandy loam soil pH 7.4; 1.7% OM. The amounts of degradates MBC and DX-105 were about the same in the dark control and the irradiated samples; the amount of parent was less in the irradiated samples. The amounts of soil residues were higher in the irradiated soils which may suggest that photoreactions of thiophanate-methyl on soil may lead to the formation of compounds that bound more readily to soil.

-Aerobic Soil Metabolism (162-1) MRID #106085: In a clay loam soil (pH 7.2) and two sandy loam soils (pH 5.7 and 7.5) thiophanate-methyl degraded in less than 1 day. The degradate MBC was the major degradate formed; 38-83% of applied during the first 3 weeks of the experiment. In the pH 5.7 sandy loam soil MBC was found at 36% of the applied after 12 months; in the clay loam soil, at 22% of the applied. MBC was found at 1% in the pH 7.5 sandy loam soil. CO_2 evolution and bound residues increased with time. Bound residues were the highest in the pH 7.5 soil (76% after 12 months). Other degradates detected were FH-432 and DX-105 at <10% of the applied at all times.

-Anaerobic Aquatic Metabolism (162-3) MRID #40061501: Thiophanate-methyl degraded in a silt loam soil (pH 6.2):water system with a half-life of <1 day. The major degradates detected were MBC (66% after 1 day in water phase). The amount of MBC declined with time in both phases. The degradates AV-1951, DX-105 and FH-432 were also detected, particularly in the aqueous phase during the first week at <10% of applied. None of these degradates were detected in the aqueous phase after 12 months and only DX-105 and FH-432 were in the soil after 12 months.

-Leaching/Adsorption/Desorption (163-1) MRID#42351001: Thiophanate-methyl, DX-105, and FH-432 bind to soils relatively poorly with K_{ads} ranging from 0.27 to 14.1. Thiophanate-methyl, DX-105, and FH-432 are relatively easy to desorb from soil and are therefore expected to be mobile. However K_{ads} values of MBC (K_{ads} 0.45 to 88.2) are nearly equal to the K_{des} values (K_{des} 0.33 to 161) indicating that MBC is not readily desorbed from the soil.

-Terrestrial Field Dissipation (164-1A) MRID #41930101: Thiophanate-methyl (TM) applied to an apple orchard at 0.35 lb ai/acre dissipated too rapidly even at time 0 to form MBC and allophanate. MBC dissipated with a registrant-calculated half-life of 22 days. Neither parent nor degradates leach below 8 cm.

-Terrestrial Field Dissipation (164-1B) MRID #41930102: Thiophanate-methyl (TM) degraded with a half-life of 1 day in the top 3 inches cm of loamy sand soil. No TM was detected in soil 12 months after last treatment. Major degradate were MBC, and allophanate. MBC degraded in the top 6 inches of soil with an author calculated half-life of 94 days. MBC was not detected in soil 12 months after last treatment. Allophanate was not found above detection limits at any soil depth below 6 inches depth.

-Terrestrial Field Dissipation (164-1C) MRID# 43433701: Thiophanate-methyl (TM) degraded with a half-life of 4.2 day in the top 6 inches of sandy loam soil. No TM was detected in soil 14 days after last treatment. Major degradate was MBC. MBC degraded in the top 6 inches of soil with an author calculated half-life of 33.9 days. No MBC was detected in soil 120 days after the last treatment. No FH-432 or DX-105 were found above detection limits at any soil depth.

<u>Not Satisfied</u>:

-Laboratory Volatility (163-2) MRID# 42380101.

The volatility of thiophanate-methyl from a viable soil was investigated on Sand soil (pH 8.0, OM% 0.2) applied at a rate of 46.4 Fg/cm^2. No radioactivity in the water trapped with the cold trap bottle was detected. Likewise no radioactivity was found in the polyurethane, or the ethanol trap. Small amounts (0.3% of the applied radioactivity) were detected in the KOH solution in one of the two test chambers.

Waived:

-Bioaccumulation in Fish (165-4) DP Barcode 169085 EFGWB #91-1000

Reserved:

-Field Volatility (163-3)
-Long Term Terrestrial Field Dissipation (164-5)
-Aquatic Non-Target Organisms (165-5)
-Ground and/or Surface Water Monitoring
-Droplet Size Spectrum ((201-1)
-Field Spray Drift Evaluation ((202-1)

Summary of MBC studies used in support of TM registration :

161-1. Hydrolysis. The requirement is satisfied by Acc.# 00151418, 1985. At pH 5, the half-life of benomyl was 3.5 hr., major degradate was MBC. At pH 7, the half-life of benomyl was 1.5 hr., the major degradates were MBC (approx. 75% of total radioactivity) and (STB) at 25% of total radioactivity. At pH 9, the half-life of benomyl was less than 1 hr., the major degradate was (STB) at 80% of total radioactivity. MBC appeared to be stable to hydrolysis over the studies duration.

161-2. Photodegradation in Water. The requirement is satisfied by Acc.# 00151419, 1985. Phenyl labeled [14C]benomyl (radiochemical purity >99%), at 1 ppm, degraded with a half-life of < 4 hours in a sterile aqueous buffered solution (pH 5) maintained at 25 C, whether the solution was irradiated with natural sunlight or incubated in the dark. Under both conditions the major degradate (> 99% of applied) was MBC, STB was present at 1%. At the end of the 30 day study MBC represented 99% of the applied. A photodegradation half-life was not established for MBC; however, available data suggest that MBC is stable to photodegradation.

161-3. Photodegradation on Soil. The requirement is satisfied by Acc.# 00151420, 1985. Phenyl-labeled [14C]benomyl (radiochemical purity >99%), at approx. 1 lb. ai/A, degraded with a half-life of < 4 days on nonsterile silt loam soil irradiated with natural sunlight at 25 C. [14C]Benomyl degraded completely in < 15 days on silt loam soil, whether the soil was irradiated or maintained in darkness. Under both conditions, the major degradate (approx. 100% of applied) was MBC, 2-AB comprised <2.0% of the applied. At the end of the 32 day study MBC represented >99% of the applied. A photodegradation half-life was not established for MBC; however, available data suggest that MBC is stable to photodegradation.

162-1. Aerobic Soil Metabolism. The requirement is satisfied by MRID# 41255801, 1989. The calculated half-life of benomyl was 19 hours in nonsterile silt loam soil, pH 6.5. The major degradate was (MBC), which degraded with a registrant-calculated half-life of >320 days. Two other nonvolatile degradates were (2-AB) and (BUB).

162-3. Anaerobic Aquatic Metabolism. The requirement is satisfied by MRID# 41137701, 1989. Benomyl's half-

life was not established. The half-life of MBC was 743 days in a clay loam soil, pH 7.4, that was treated with 1 ppm (equivalent to 1 lb/ai/A) [14C]Benomyl and incubated for up to 365 days. (STB), the only other degradate detected reached a maximum of 7.6% of the recovered radioactivity (0.10 ppm) at 365 days posttreatment.

162-4. Aerobic Aquatic Metabolism. The requirement is satisfied by MRID #41291501, 1989. Benomyl's half-life was not established. The half-life of MBC was 61 days in a clay loam soil:water system, pH 7.3, that was treated with 2 ppm (equivalent to 2 lb/ai/A) [14C]Benomyl and incubated for 30 days. The major degradate (STB) reached a maximum of 28.8% of the recovered radioactivity then dropped to non-detectable at day 14. (BUB) reached 1.54-2.30% of the recovered radioactivity (0.03-0.05 ppm) immediately posttreatment to 1 day posttreatment, and was not detected (<0.01 ppm) at 7 days. (2-AB) was $\leq$0.083% of the recovered radioactivity (0.02 ppm) at all sampling intervals.

163-1. Leaching and Adsorption/Desorption. The requirement is satisfied. Acc.# 00151421, 1985: Phenyl-labeled [14C]benomyl and its degradates, including MBC, STB, and 2-AB were immobile (>85% of applied remained in the upper 2 inches, > 95% in upper 4 inches) in columns (13-inch length) of two silt loam (Flanagan and Seaport) and two sandy loam (Cecil and sassafras) soils. The columns were treated with *unaged* and *aged* residues at 1.2-1.6 lb ai/A and leached with 20 inches of water.

Acc.# 00151422, 1985: Phenyl-labeled [14C]benomyl and its degradates, including MBC, STB, and 2-AB were immobile in two silt loam and two sandy loam soils as measured by batch equilibrium and soil TLC studies. Freundlich Kdads values for benomyl and its degradates (carbendazim, {MBC}) in batch equilibrium studies ranged from 6.1 to 90 and 1/n values ranged from 0.80 to 0.89; Rf values for the soil TLC were 0.00-0.16. Kd_{des} values established for benomyl and its degradates (carbendazim {MBC}) were 2.5 in a Woodston sandy loam 1.1% OM; 2.5 in a Cecil sandy loam 2.1% OM; 2.5 in a Flanagan silt loam 4.3% OM; and 2.4 in a Keyport silt loam with 7.5% OM.

164-1. Terrestrial Field Dissipation. MRID# 43941301, 1996: Benomyl dissipated with a registrant calculated first order half-life of 86 days in a loam soil in California and 15 days in a sandy soil in Florida after an application of 7.0 lbs ai/acre. Benomyl was detected to the 75- to 90- cm depth at the California site and at 15- to 30- cm depth at the Florida site. For both sites, the appearance of benomyl at these depths is suspected to result from contamination with soil from shallower depths. The degradate 2-AB (2-aminobenzimidazole) was detected at both sites.

165-4. Accumulation in Fish. Satisfied, Acc. No. 260573, 1985; Bluegill sunfish exposed to 2 concentrations of carbendazim, 0.018 mg/l and 0.17 mg/l for 4 wks. showed maximum BCF's in whole fish of 27 and 23 at the low and high exposures, respectively. Peak viscera BCF's were 460 and 380 for low and high exposures, respectively. Little occurred in muscle tissue (<4 BCF) or the remaining carcass. After 14 days of depuration >94% decrease in whole fish, viscera, and muscle. (Acc. No. 260573)

163-2, 163-3. Laboratory and field volatility. Requirements for studies of volatility have been waived. The low vapor pressure of benomyl (3.7×10^{-8} torr) indicates low volatility.

DATA EVALUATION RECORD
DER 1

SHAUGHNESSY No. 102001
COMMON NAME: Thiophanate-methyl
CHEMICAL NAME: Dimethyl[1,2-phenylenebis(iminocarbonothioyl)]biscarbamate
FORMULATION: Not formulated, pure active ingredient, ^{14}C-labeled.
DATA REQUIREMENT: Leaching/Adsorption/Desorption (163-1)

MRID No: 42351001
Hironnori Shiotani. April 6, 1992. Thiophanate-methyl- Batch Equilibrium (Adsorption/Desorption on Soils). Performed by Environmental toxicology Laboratory 345 Takada, Odawara, Kanagawa 250-02, Japan. Sponsored by Mitsuo HattoriAmvac Chemical Corporation 4100 East Washington blvd. Los Angeles CA 90023. Laboratory Project ID No. NISSO EC-362.

REVIEWED BY: Ibrahim Saheb/AGRONOMIST **Signature:**
FMB/EFED

Date:

PEER REVIEWED BY: Kevin Poff/CHEMIST **Signature:**
FMB/EFED

Date:

CONCLUSIONS:

1-This study conducted with thiophanate-methyl and its degradate, MBC, FH-432, and DX-105 is acceptable and can be used toward satisfying the mobility in soil (163-1) data requirement for unaged thiophanate-methyl.

2-There is a high uncertainty in K_d values for Thiophanate-methyl and the degradate DX-105 due to the fact that these values were calculated for non-equilibrium conditions. A 6 hour shaking time was chosen because data suggests that thiophanate-methyl degrades to MBC by 8 hours.

3-The registrant-calculated Freundlich adsorption coefficients (K_{ads}) for thiophanate-methyl and its degradates were (a) in sandy loam 0.66 (1/n 0.903, % OM 0.6, pH 7.1);(b) loam 0.97 (1/n 0.827, % OM 1.2, pH 6.4); sand 0.27 (1/n 0.894, % OM 0.2, pH 8.0); clay loam 14.1 (1/n 0.754, % OM 2.8, pH 5.2); loam 1.47 (1/n 0.789, % OM 0.7, pH 6.9); loamy sand 1.46 (1/n 0.774, %OM 2.1, pH 6.5). The corresponding (K_{oc}) values were 188.6, 136.6, 225.0, 858.8, 358.5, and 117.7, respectively. The K_{ads} coefficients for thiophanate-methylwere similar to that of the degradates DX-105 (0.29 to 11.9),and FH-432 (0.28 to 10.11), while the K_{ads} coefficients of the degradate MBC (0.45 to 88.24) were the highest. The K_{des} values of thiophanate, DX-105, and FH-432 are greater than K_{ads} values of each compound. Therefore thiophanate-methyl,DX-105, and FH-432 are relatively easy to desorb from soil and are expected to be mobile. However K_{ads} values of MBC are nearly equal to the K_{des} values indicating that MBC is not readily desorbed from the soil.

METHODOLOGY:

The mobility of ^{14}C-thiophanate- methyl and its degradates MBC, DX-105, and FH-432 were studied at a concentrations of 0.21, 0.86, 3.47, and 14.3 ppm (thiophanate-methyl), 0.21, 0.62, 1.90, and 3.73 ppm MBC), 0.17, 0.93, 3.55, and 13.9 ppm (DX-105), 0.21, 0.75, 3.20, and 12.5 ppm (FH-432) in four upland soils (sand, sandy loam, loamy sand and loam) and two paddy soils (loam and clay loam). Non-sterilized Soils were passed through a 2 mm sieve). Radiopurities were determined by the study author and reported to be 98.2% (thiophanate-methyl), 97.8% (MBC), 95.6% (DX-105),and 96.8% (FH-432) using TLCs. The test solutions were prepared using 0.01 M calcium nitrate solution. Each soil sample (10 g) was mixed with an aliquot (20 mL) of the calcium nitrate test solution added at room temperature (approximately 25±1°C), resulting in a soil:solution ratio of 1:2. All soil:aqueous solution mixture in test tubes were wrapped in aluminum foil, mixed and then shaken on a mechanical shaker in the dark at 25±1°C for up to 6 hours. After 6 hour of equilibration, all the supernatant (treated 0.01 M calcium nitrate solution) was decanted in to clean tubes and duplicate aliquots of the supernatant taken and the radioactivity was determined using HPLC.

After 6 hours of equilibration, fresh calcium nitrate solution was added to the soil in each tube. The tubes were shaken for 6 hours in the dark at a constant temperature (25±1°C). The supernatant was decanted. This desorption test was repeated on the same soil. Duplicate aliquots of each supernatant were analyzed by HPLC.

The soil residue remaining after the desorption study was extracted with 20 mL of methanol. The methanol extracts were then analyzed by LSC. Soils with low radioactivity recovery were air- dried and the bound residue was determined by combustion of the soils, followed by LSC.

The adsorbed amount of compound, Freundlich adsorption constants and adsorption coefficient (K_{ads}, I/n, and K_{oc}) were determined by the following equations:

Equation 1 $X= (C_o-c_e)*V/W$

Equation 2 $X = K_{ads} * C_e^{1/n}$

Equation 3 $K_{oc} = K_{ads} * (100/O.C)$

where x: equilibrium concentration in soil (Fg/g)
C_o :initial concentration in water (Fg/mL)
C_e: equilibration in water (Fg/mL)
V: volume of test solution (mL)
W: weight of soil (g)
K_{oc}: adsorption coefficient based on organic carbon
O.C= Organic matter/1.7

The freundlich desorption constants (K_{des}, and 1/n') were determined by the following equations:

Equation 4 $X' = X - 2C_e'$

Equation 5 $X'' = X' - 2C_e''$

Equation 6 $C' = C_e' + C_e''$

Equation 7 $X'' = k_{des} * C'^{1/n'}$

where X': equilibrium concentration of compound remaining in soil after 1st desorption (Fg/g)X": equilibrium concentration of compound remaining in soil after 2nd desorption (Fg/g)C_e':equilibrium concentration in water after 1st desorption (Fg/mL)C_e": equilibrium concentration in water after 2nd desorption ((Fg/mL)C':total concentrations of compound desorbed from soil after the 1st and 2nd desorption (Fg/g)

DATA SUMMARY:

^{14}C-thiophanate-methyl adsorbed with a registrant calculated Freundlich K_{ads} values of 0.66 (r^2=0.998, 1/n =0.93) in sandy loam, 0.97 (r^2=0.999, 1/n=0.827) in loam, 0.27 (r^2=0.997, 1/n=0.894) in sand, and 14.1 (r^2=0.996, 1/n=0.754) in clay loam, 1.47 (r^2=0.999, 1/n=0.789) in loam, 1.46 (r^2=0.992, 1/n=0.774) in loamy sand (Table VIII). The corresponding K_{des} values were 1.51, 2.06, 0.45, 40.5, 2.11, and 2.77, respectively (Table VIII).

^{14}C-MBC adsorbed with a registrant calculated Freundlich K_{ads} values of 3.77 (r^2=0.973, 1/n =0.77) in sandy loam, 4.74 (r^2=0.991, 1/n=0.712) in loam, 0.45 (r^2=0.942, 1/n=0.827) in sand, 88.2 (r^2=0.912, 1/n=0.609) in clay loam, 4.47 (r^2=0.974, 1/n=0.752) in loam, and 5.71 (r^2=0.985, 1/n=0.747) in loamy sand (Table VIII). The corresponding K_{des} values were 2.95, 3.97, 0.33, 161, 3.20, and 4.87, respectively (Table VIII).

^{14}C-DX-105 adsorbed with a registrant calculated Freundlich K_{ads} values of 0.73 (r^2=0.988, 1/n =0.90) in sandy loam, 0.93 (r^2=0.990, 1/n=0.880) in loam, 0.29 (r^2=0.989, 1/n=0.907) in sand, 11.9 (r^2=0.997, 1/n=0.766) in clay loam, 1.32 (r^2=0.995, 1/n=0.855) in loam, and 1.42 (r^2=0.991, 1/n=0.845) in loamy sand (Table VIII). The corresponding K_{des} values were 1.58, 2.28, 0.30, 17.5, 1.90, and 2.64, respectively (Table VIII).

^{14}C-FH-432 adsorbed with a registrant calculated Freundlich K_{ads} values of 0.67 (r^2=0.999, 1/n =0.935) in sandy loam, 0.75 (r^2=0.999, 1/n=0.913) in loam, 0.28 (r^2=0.999, 1/n=0.926) in sand, 10.1 (r^2=0.997, 1/n=0.809) in clay loam, 1.06 (r^2=0.999, 1/n=0.900) in loam, and 1.31 (r^2=0.999, 1/n=0.864) in loamy sand (Table VIII). The corresponding K_{des} values were 1.25, 1.42, 0.08, 10.3, 0.98, and 2.01, respectively (Table VIII).

The 1/n values indicate that adsorption is fairly linear. K_{ads} is a measure of the amount adsorbed which is in equilibrium with a solution of unit concentration. The higher the value of K_{ads}, the stronger the adsorption. Thus, K_{ads}-values compare both the capacity of different soils to adsorb a particular chemical and the relative absorbability of different chemicals on the same soil. Soils in which $K_{des} >> K_{ads}$ will more readily desorb the compound than soils in which $k_{des} \# K_{ads}$. The K_{des} values for thiophanate-methyl, DX-105, and FH-432 are greater than K_{ads} values of each compound, indicating that these compound are weakly adsorbed. Therefore, thiophanate-methyl, DX-105, and FH-432 are potentially mobile in soils.

COMMENTS:

*** Six soils were used in this study. However, subdivision N guideline require the mobility study to be conducted using four soils only.**
*** Equilibration time for thiophanate-methyl used in this study was 6 hours instead of a minimum of 24 hours as required by subdivision N guideline.**
*** According to the study author, data suggest that thiophante-methyl degrades to MBC by 8 hours, therefore, an adsorption period of 6 hours was chosen for the definitive phase of this study.**
*** The degradate selected in this study were observed in an aerobic soil metabolism study (MRID# 00106085).**
*** Detection limit was reported for HPLC in this leaching study to be 0.001 ppm (48 dpm/0.5 mL at 0.21 ppm initial concentration of thiophanate-methyl.**
*** Prior to use, soils were stored at 7±1 ºC.**
*** Organic C amount was calculated from the amount of organic matter present in soil using the following equation:**
OC%= OM% ÷ 1.7

DATA EVALUATION RECORD
DER 2

SHAUGHNESSY No. 102001
COMMON NAME: Thiophanate-methyl
CHEMICAL NAME: Dimethyl[1,2-phenylenebis(iminocarbonothioyl)]biscarbamate
FORMULATION: 70% WP, ^{14}C-labeled.
DATA REQUIREMENT: Laboratory Volatility (163-2)

MRID No: 42380101
Hironnori Shiotani. May 28, 1992. Thiophanate-methyl- Laboratory Volatility from Soil. Performed by Environmental toxicology Laboratory 345 Takada, Odawara, Kanagawa 250-02, Japan. Sponsored by Nippon Soda Co., Ltd. 2-1, 2-Chome, Ohtemachi Chiyoda-Ku, Tokyo 100, Japan. Laboratory Project ID No. NISSO EC-381.

REVIEWED BY: Ibrahim Saheb/AGRONOMIST **Signature:**
FMB/EFED

Date:

PEER REVIEWED BY: Kevin Poff/CHEMIST FMB/EFED	**Signature:**
	Date:

CONCLUSIONS:

1- This study is scientifically sound, even though the relative humidity in the test chambers was not reported. Therefore, the results are considered supplemental and upgradeable to acceptable upon receipt of test chamber relative humidity data.

2- No volatiles derived from thiophanate-methyl and its degradates were detected in this experiment.

METHODOLOGY:

The volatility of thiophanate-methyl from a viable soil was investigated on sand soil (pH 8.0, OM% 0.2) that was passed through a 2 mm sieve. Topsin^{R} M 70% WP containing [ring U-^{14}C]thiophanate-methyl was applied at a rate of 46.4 Fg/cm^{2}. Soil samples (70 g, 11.2% moisture content) was placed in 4 petri dishes (94 mm i.d. X 20 mm h) homogeneously in drops on the soil surface with a 1 mL pipette. Dishes were placed in 2 sealed test chambers that were incubated in the dark at 35±1 ºC and moist air was passed over the soil surface at a flow rate of 250 to 270 mL/min for 17 days. The air leaving the test chambers first entered a cold trap bottle immersed in a cold water bath, then a ployurethane foam trap, followed by an ethanol trap and a 0.1 N KOH solution.

Aliquots of water in the cold trap, and of the ethanol and KOH solutions in the gas washing bottles were directly counted for the radioactivity. The polyurethane foam was extracted with a mixture of n-hexane:methanol (3:7) by a soxhlet for 2 hours. The soil in the petri dish was extracted twice with a 20% aqueous methanol for 30 minutes. The combined methanol extracts were mixed with 200 mL distilled water and the mixtures were shaken with 500 mL dichloromethane and the ^{14}C-compounds were analyzed by two-dimensional TLC. The soil residue remaining after extraction was air-dried and weighed. The bound residue was determined by combustion of the soil, followed by LSC analysis.

DATA SUMMARY:

The volatility of thiophanate-methyl from a viable soil was investigated on Sand soil (pH 8.0, OM% 0.2) applied at a rate of 46.4 Fg/cm^{2}. No radioactivity in the water trapped with the cold trap bottle was detected. Likewise no radioactivity was found in the polyurethane, or the ethanol trap. Small amounts (0.3% of the applied radioactivity) were detected in the KOH solution in one of the two test chambers (Table VI).

The recovered radioactivity in the dichloromethane extracts indicates that thiophanate-methyl was degraded in soil. The major degradate was MBC which accounted for up to 23% of the applied radioactivity. Other minor degradates include DX-105 which accounted for up to 2.0%, and FH-432 which accounted for up to 0.5% of the applied radioactivity, respectively. Unidentified degradates detected were account for up to 3.1% of the applied radioactivity (Table VI).

The recovered radioactivity on each soil ranged 92.8 to 99.0% for study No. 1, and 96.7 to 103.4% for study No. 2 (Table V).

COMMENTS:

*** An acceptable study (MRID# 41482802 of 1990) reported that the vapor pressure of thiophanate-methyl was less than 1.3X10^{-5} Pa at 25 ºC.**

*** The water solubility and the molecular weight for thiophanate-methyl are 21.8 ppm (25 oC), and 343 respectively.**

*** Relative humidity of air in a test chamber was not reported in this study.**

*** Only one soil was used in this volatility study.**

*** The efficiency of LSC apparatus used in this study was not reported.**

*** A detection limit was reported for LSC in this study to be 0.022 ppm at 22 ppm initial concentration of thiophanate-methyl.**

*** Prior to use, soils were stored at 7±1 ºC.**

*** In the results section of this study, the percent recoveries of radioactivity in the trapping solutions were reported to be shown in Table IV instead of Table VI.**

DATA EVALUATION RECORD
DER 3A

SHAUGHNESSY No. 102001
COMMON NAME: Thiophanate-methyl
CHEMICAL NAME: Dimethyl [(1,2-phenylene)-bis(iminocarbonothioyl)] bis[carbamate]
FORMULATION: Flowable formulation
DATA REQUIREMENT: Field Dissipation (164-1)

MRID No: 41930101
Robert G. Dykeman. March 1, 1991. Field Dissipation Study for Thiophanate-methyl applied to an apple orchard. Performed by Hazelton Wisconsin, 3301 Kinsman Boulevard Madison, WI 53704. Sponsored by Atochem North America, Inc. 201 West Dodge Street, Bryan, TX 77801. Laboratory Study Number 6012-188.

REVIEWED BY: Ibrahim Saheb/Agronomist **Signature:**
FMB/EFED

Date:

PEER REVIEWED BY: Kevin Poff/Chemist **Signature:**
FMB/EFED

Date:

CONCLUSIONS:

1. Study MRID# 41930101 is acceptable and can contribute towards satisfying the terrestrial field dissipation (164-1)data requirement for thiophanate-methyl.

2. In order for the registrant to fully satisfy the field dissipation study (164-1) data requirement for thiophanate-methyl (TM), a bare-ground study is required with TM applied at the highest recommended label rate. Subdivision N guideline No. 164-1 requires a bare-ground study if intended application is to orchard.

3. Thiophanate-methyl (TM) applied to an apple orchard at 0.35 lb ai/acre dissipated rapidly to MBC and allophanate and could not be detected at day 0. MBC dissipated with a registrant-calculated half-life of 22 days. Neither parent nor degradate leached below 8 cm.

4. Registrant-calculated average analytical recoveries range from 59.0% to 96.8 for TM, 100% to 124% for MBC, and 92.0 to 119% for allophanate.

METHODOLOGY:

A single trial was conducted in an apple orchard in upstate New York under actual terrestrial use conditions. Ten applications of flowable formulation of Topsin 4.5F were applied to a sandy loam soil (pH= 6.7, OM%=1.3) at an application rate of 0.35 lb a.i/acre. A rate of 0.35 lb ai/acre is 50% of the lowest label rate of 20 fl oz formulation/acre. The study site consists of two plots, each divided into 100 sampling squares, with each 9 X 9 m square containing one apple tree with the exception of squares C4 and J4, where the trees were missing. The control and the treated plots were 108 m apart. Applications of Topsin 4.5F were made with a commercial airblast ground sprayer. Eight applications were made in accordance with the label at 5 or 6 day intervals. Two final applications were then made at 5 day intervals.

In the treated plot, three soil cores were taken randomly from each of five sampling squares on each date. In the control plot, three to four cores were taken from each of three to five sampling squares on each sampling date. Soil cores were collected using a 2.5 cm diameter hand corer fitted with an acetate liner. Soil cores were taken two days prior to the first application, following each application, and at 1, 2, 3, 4, 6, 9 and 12 months after the final application (M1-M12). Soil cores were taken to a depth of 30 cm, except for the 12 month samples, which were taken to a depth of 90 cm. Each soil core and liner was cut into 7.5 cm segments. Segments from the same depth in each of the three (or four) cores from the same sampling square were sieved through a 2mm sieve and composited. Composited soil samples were then analyzed for thiophanate-methyl (T-M), and its two degradates methyl-2-benzimid-azole carbamate (MBC) and dimethyl-4-4'-o-phenylenebis (allophate). Samples from control and treated plots from the pre-application through six months after final application (M6) were analyzed.

A 100 gm soil sample was extracted with methanol:water, then methanol was removed by evaporation. The remaining aqueous phase was extracted three times with chloroform. The chloroform then evaporated to a small volume, methanol was added, and the liquid is again evaporated to a small volume, then filtered. Residues were quantified by High Performance liquid Chromatography (HPLC) for analysis of thiophanate-methyl (TM) and its degradates MBC, and allophanate. The HPLC was equipped with ultraviolet detector. The HPLC detection limit was 0.05 ppm for all analytes.

DATA SUMMARY:

An apple orchard was treated with Topsin 4.5F at a rate of 0.35 lb ai/acre (one-half label rate) dissipated with a registrant-calculated half-life of 1 day. Thiophanate-methyl (TM) was found above the detection limit following the first application ranging from 9.83 to 0.05 ppm and only in the top 7.5 cm of soil. Following the second application, TM residue range from 0.17 to 4.45 ppm, and the residue level continued to decline following the third and fourth

application ranging from 0.05 to 0.73 ppm interval. M9 samples were not analyzed, therefore no conclusion can be made about TM residue levels in soil during this period. No detectable TM residues were found from interval M12 to M18. TM was found below 7.5 cm depth stratum in three samples: one sample at M2 interval , and two samples at M6 interval (Table XVIII)

Detectable residues of MBC were found in the top 7.5 cm of soil following the first application ranging from 0.38 to .65 ppm. These levels peaked at 0.61 ppm at P4. Thereafter MBC residues continued at levels from 0.25 to 0.45 ppm through M6. MBC was detected below the 7.5 cm layer at levels ranging from 0.06 to 0.1 ppm during the period M2 through M6. No MBC residues were detected at any depth after M6 (Table XVIII).

Detectable residues of allophanate were found in three samples in the 0-7.5 cm stratum ranging from 0.06 to 0.08 ppm. Confirmatory reanalysis of these samples resulted in non-detectable residues.

The average soil analytical method concurrent recoveries were 88% for TM, 103% for MBC, and 103% for allophanate (Table VII). The field spiked recoveries ranged from 52% to 102% for TM, 92% to 140% for MBC, and 86% to 127% for allophanate (Table VIII).

COMMENTS:

*** The longest sample storage time for all but one set of samples was 6 months.**

*** Study author reported that no detectable TM residues were found from interval M12 to M18 but soil analysis for samples M9- M18 were not reported in Table XVIII.**

*** Coefficient of determination (r^2) for MBC ranges from 0.599 to 0.966 .**

*** No crop samples were taken for analysis in this study.**

*** Samples from control and treated plots of the 9 and 15 months after last application were not analyzed.**

*** Soil cores sampled prior to the 12-month interval after final application) were taken to a depth of 30 cm depth. Soil cores for the 12, 15, and 18 month intervals were taken to 90 cm depth.**

*** Similar field dissipation studies (MRID # 43433701;41930102)showed a corresponding half-lives of 4.2, and 1 days, respectively.**

*** Results from this study were similar to that of laboratory aerobic soil metabolism (MRID # 00106085). Both studies indicated that TM dissipate rapidly, and MBC was the major degradate.**

*** Thiophanate-methyl was applied to an apple orchard at one-half the maximum label rate (0.35 lb a.i/acre).**

*** Data on plot area slope, depth to water table, climatological data, and storage stability data were reported in this study.**

*** At this time EFED believes that this study was not conducted properly. Useful information can be produced from this study since these results are not different from laboratory studies in regard to the environmental fate of thiophanate- methyl.**

DATA EVALUATION RECORD
DER 3B

SHAUGHNESSY No. 102001
COMMON NAME: Thiophanate-methyl
CHEMICAL NAME: Dimethyl [(1,2-phenylene)-bis(iminocarbonothioyl)] bis[carbamate]
FORMULATION: Flowable formulation
DATA REQUIREMENT: Field Dissipation (164-1)

MRID No: 41930102
Robert G. Dykeman. March 27, 1991. Field Dissipation Study for Thiophanate-methyl applied to a dry bean crop.

Performed by Hazelton Wisconsin, 3301 Kinsman Boulevard Madison, WI 53704.Sponsored by Atochem North America, Inc. 201 West Dodge Street, Bryan, TX 77801. Laboratory Study Number 6012-186.

REVIEWED BY: Ibrahim Saheb/AGRONOMIST Signature:
FMB/EFED

Date:

PEER REVIEWED BY: Kevin Poff/CHEMIST Signature:
FMB/EFED

Date:

CONCLUSIONS:

1. **Study MRID# 41930102 is acceptable and satisfies the terrestrial field dissipation study (164-1) data requirement for Thiophanate-methyl.**
2. **Thiophanate-methyl (TM) dissipated with a half-life of 1 day in the top 7.5 cm of loamy sand soil. No TM was detected in soil after 12 months after last treatment. The major degradates were MBC, and allophanate. MBC dissipated in the top 6 inches of soil with an author calculated half-life of 94 days. MBC was not detected in soil after 12 months after last treatment. Allophanate was not found above detection limits at any soil depth below 6 inch depth..**
3. **Registrant-calculated average analytical recoveries were 88% for TM, 103% for MBC, and 103% for allophanate.**

METHODOLOGY:

A single trial was conducted in central California under actual terrestrial use conditions. Four application of flowable formulation of Topsin 4.5F were applied to a sandy loam soil (pH= 6.0, OM%=0.5) cropped with dry beans at an application rate of 2.8 lb ai/acre (first application), and 1.4 lb a.i/acre (final three applications). The study site consists of two plots (50 x 50 ft each) that are 150 ft apart. Both plots were divided into sub-plots; each contain 100 subsections. First application of Topsin 4.5F was made using a CO_2 backpack sprayer, and the final three applications were made with a two-spray boom. The applications were made at the following growth stages: pre-plant, 10%-30% bloom, small beans, and large beans.

Within each sub-plot, three soil cores taken randomly from each of four sub-plot in the control plot, and three core from each of five sub-plots in the treated plot on each sampling date. Soil cores were collected using a 2.5 cm diameter hand corer fitted with an acetate liner. Preapplication cores were taken on the day of the first spay prior to application. Cores were then taken after each of the four applications on the application day (P1-P4), and at 1, 2, 3, 4, 6, 9, 12, 15, and 18 months after the final application (M1-M18). Soil cores sampled prior to the 12-month interval after final application) were taken to a depth of 30 cm depth. Soil cores for the 12, 15, and 18 month intervals were taken to 90 cm depth. Each soil core and liner was cut into four segments 0-7.5, 7.5-15, 15-22.5, and 22.5-30 cm depths. Soil from the same depth segment of each of the three cores within a sampling sub-plot was composited, sieved through a 2mm sieve before analysis.

Overhead irrigation using risers with the timing and amounts used for typical growing seasons was applied to the control and the treated plots.

Samples from control and treated plots from the pre-application through eighteen months after final application (M18) were analyzed, with the exception of the M9 and M15 samples (9 and 15 months after final application, respectively).

A 100 gm soil sample was extracted with mehtanol:water, then methanol was removed by evaporation. The remaining

aqueous phase was extracted three times with chloroform. The chloroform then evaporated to a small volume, methanol was added, and the liquid is again evaporated to a small volume, then filtered. Residues were quantified by High Performance liquid Chromatography (HPLC) for analysis of thiophanate-methyl (TM) and its degradates MBC, and allophanate. The HPLC was equipped with ultraviolet detector. The HPLC detection limit was 0.05 ppm for all analytes.

DATA SUMMARY:

Topsin 4.5F applied to a sandy loam soil cropped with dry beans at an application rate of 2.8 lb ai/acre (first application), and 1.4 lb a.i/acre (final three applications) dissipated with a registrant-calculated half-life of 1 day. Thiophanate-methyl (TM) was found above detection limit following the first application ranging from 9.83 to 0.05 ppm and only in the top 7.5 cm of soil. Following the second application, TM residue range from 0.17 to 4.45 ppm, and the residue level continued to decline following the third and fourth application ranging from 0.05 to 0.73 ppm. Interval M9 samples were not analyzed, therefore no conclusion can be made about TM residue levels in soil during this period. No detectable TM residues were found from interval M12 to M18. TM was found below 7.5 cm depth stratum in three samples: one sample at interval M2, and two samples at interval M6 (Table XVIII)

Detectable residues of MBC were found in the top 7.5 cm of soil following the first application ranging from 0.38 to 0.65 ppm. These levels peaked at 0.61 ppm at interval P4. Thereafter MBC residues continued at levels from 0.25 to 0.45 ppm through interval M6. MBC was detected below the 7.5 cm layer at levels ranging from 0.06 to 0.1 ppm during the period M2 through M6. No MBC residues were detected at any depth after interval M6 (Table XVIII).

Detectable residues of allophanate were found in three samples in the 0-7.5 cm stratum ranging from 0.06 to 0.08 ppm. Confirmatory reanalysis of these samples resulted in non-detectable residues.

The average soil analytical method concurrent recoveries were 88% for TM, 103% for MBC, and 103% for allophanate (Table VII). The field spiked recoveries ranged from 52% to 102% for TM, 92% to 140% for MBC, and 86% to 127% for allophanate (Table VIII).

COMMENTS:

* **The longest sample storage time for all but one set of samples was 6 months.**
* **Poor coefficient of determination (r^2) for TM and MBC (0.77 and 0.85), respectively.**
* **No crop samples were taken for analysis in this study.**
* **Samples from control and treated plots of the 9 and 15 months after last application were not analyzed.**
* **Table XVIII shows that interval P1 samples thiophanate-methyl and MBC mean residue to be 4.13 ppm. The initial TM concentration applied was only 2.8 ppm.**
* **Soil cores sampled prior to the 12-month interval after final application) were taken to a depth of 30 cm depth. Soil cores for the 12, 15, and 18 month intervals were taken to 90 cm depth.**
* **Registrant-calculated half-lives for TM and MBC were 1, and 94 days, respectively. Similar field dissipation study (MRID # 43433701) showed a corresponding half-lives of 4.2, and 34 days,respectively.**
* **Results from this study were similar to that of laboratory aerobic soil metabolism (MRID # 00106085). Both studies indicated that TM dissipate rapidly, and MBC was the major degradate.**
* **Thiophanate-methyl was applied to plot area cropped with dry bean at a rate of 1.4 lb a.i/acre.**
* **Data on plot area slope, depth to water table, climatological data, and storage stability data were reported in this study.**

Topsin M 70W.

* **At this time EFED believes that this study was conducted properly and produce results that are not different from laboratory studies in regard to the behavior of thiophanate-methyl.**

DATA EVALUATION RECORD
DER 3C

SHAUGHNESSY No. 102001
COMMON NAME: Thiophanate-methyl
CHEMICAL NAME: Dimethyl [(1,2-phenylene)-bis(iminocarbonothioyl)] bis[carbamate]
FORMULATION: Wettable powder (70% a.i)
DATA REQUIREMENT: Field Dissipation (164-1)

MRID No: 43433701
Jeannie Wright. October 7, 1994. Terrestrial Dissipation of Topsin-M Applied to a Lettuce Crop. Performed by Plant Sciences, Inc. 342 Green Valley Road Watsonville, CA 95076, and Morse Laboratories, Inc. 1525 fulton Avenue Sacramento, CA 95825. Sponsored by Elf Atochem North America, Inc. Three Parkway, Philadelphia, PA 19103. Laboratory Study Number BR-92-30.

REVIEWED BY: Ibrahim Saheb/AGRONOMIST **Signature:**
FMB/EFED

Date:

PEER REVIEWED BY: Kevin Poff/CHEMIST **Signature:**
FMB/EFED

Date:

CONCLUSIONS:

1. **Study MRID# 43433701 is acceptable and satisfies the terrestrial field dissipation study (164-1) data requirement for thiophanate-methyl.**
2. **Thiophanate-methyl (TM) dissipated with a half-life of 4.2 day in the top 6 inches of sandy loam soil. No TM was detected in soil after 14 days after last treatment. The major degradate was MBC. MBC dissipated in the top 6 inches of soil with an author calculated half-life of 33.9 days. No MBC was detected in soil after 120 days after last treatment. FH-432 or DX-105 were not detected.**
3. **Registrant-calculated average analytical recoveries were 72% for TM, 82% for MBC, 87% for FH-432, and 86% for DX-105.**

METHODOLOGY:

A single trial was conducted in California (Santa Cruz Co.). Topsin M 70 W was applied as a wettable powder containing 70% thiophanate-methyl to a sandy loam soil (pH= 6.5, OM=2.2%) cropped with lettuce at an application rate of 1.4 lb ai/acre. Two plots were located at the site, the treated plot (90 ft X 150 ft, 0.25 acres) and the control plot (30 ft X 150 ft). Both plots were divided into sub-plots; the treated plot contained 144 subsections, and the control plots contained 48 subsections. Topsin M 70 was applied post emergence by a spray boom applicator at 1.4 lb a.i/acre which is equivalent to 2 lb/acre formulated Topsin M 70. Topsin M 70 was applied eight times; the first application following thinning and seven applications at 7 day intervals.

Within each sub-plot, five soil cores taken randomly within a single subplot on any given date to a depth of 48 inches. Soil samples were taken from the treated and the control plot prior to application. Soil samples were taken from the treated plot following each application, and at 1,3,7,14,30,60,90,120,150,180, and 210 days after the last treatment (ALT). Soil samples were taken from the control plot at application 8, 60 ALT and 210 ALT. No samples were taken following the 210 ALT sample interval. Each core was taken with Giddings soil probes in two stages: first a large diameter was used to take a 0-6 inch core. A smaller diameter probe was then driven through the existing large-

diameter hole to obtain a continuous 6-48 inch core.

The plots (treated and control) were irrigated using the same methods and schedules. Plots were irrigated with three inch aluminum surface pipe fitted with 1/8" Rainbird nozzles on 18" risers.

For each sample, approximately 10 g of soil were dried in a convection oven at 130 ºC. Soil samples were extracted twice with 100 mL of an acetic acid:methanol mixture followed by two extractions with 100 mL of an ammonium hydroxide:methanol mixture. The aqueous extract was partitioned three times with methylen chloride, then the extract was concentrated by rotary evaporation, and passed through 1'2' amino solid phase extraction column. The compounds then were eluted with cylcohexane:ethyl acetate:acetonitrile mixture. This elute was evaporated to dryness and redissolved in 5 mL of 15% methanol:85% 0.025 M potassium phosphate for high performance liquid chromatography (HPLC) analysis of thiophanate-methyl (TM) and its degradates MBC, FH-432, and DX-105. The HPLC was equipped with a variable wavelength, ultraviolet detector. The HPLC detection limit was 0.005 ppm for all analytes.

DATA SUMMARY:
Topsin M 70% wettable powder at rate of 1.4 lb a.i/acre applied to a sandy loam soil dissipated with a registrant-calculated half-life of 4.2 days. Thiophanate-methyl (TM) was found above detection limit only in the top 6 inches of soil. By the 14 ALT, no TM was found in the soil above detection limit. TM residues in the top 6 inches of soil remained at a constant level ranging from 0.356 ppm at application 1 to 0.404 ppm at application 6. A slight drop in residue levels occurred at application 7. TM residues dropped to a level of 0.245 ppm. By application 8 (day 0) residues had increased to 0.314 ppm. Following the last application, residue levels decreased and by the 14 ALT, TM residues were below detection limit (Figure 3).

Results in Table XXIII indicated that MBC residue builds up slowly during application and decreased as application ceases. MBC was found in the top 6 inches of soil, and no MBC was detected at lower depths above detection limit. MBC builds up slightly ranging from 0.0825 ppm at application 1 to 0.819 ppm at application 6, then MBC residues dropped to 0.662 ppm at application 7 and continued to drop after the last application. By 150 ALT, MBC residues were below detection limit (Figure 5). MBC dissipated with a registrant-calculated half-life of 33.9 days.
No DX-105 or FH-432 residues were not found in the soil at any depth above the detection limit.

The average soil analytical method concurrent recoveries ranged from 62% to 95% for TM, 72% to 88% for MBC, 85% to 98% for FH-432, and 79% to 92% for DX-105 (Tables XIV, XV, XVI, and XVII). The field spiked recoveries ranged from 67% to 99% for TM, 83% to 106% for MBC, 99% to 106 5 for FH-432, and 74% to 96% for DX-105 (Tables VIII, IX, X, and XI).

COMMENTS:
*** The combined thiophanate-methyl and MBC residue found immediately after first application was 0.438 ppm (Tables XXII and XXIII). The initial application was 0.7 ppm. Poor mass balance is also reported during the rest of the study.**
*** There was a controversy between the reported half-lives for TM and MBC in the summary and the one reported in results section of this study. FMB recalculated both half-lives and concluded that TM $t_{1/2}$ should be 4.2 days instead of the reported half-life of 8.6 days, and MBC $t_{1/2}$ should be 33.9 days instead of the reported half-life of 45 days. Correction was made in the supplemental report to EPA MRID # 43545801.**
*** Results from this study were similar to that of laboratory aerobic metabolism (MRID # 00106085). Both studies indicated that TM dissipate rapidly, and MBC was the major degradate.**
*** Thiophanate-methyl was applied to plot area cropped with lettuce at a rate of 1.4 lb a.i/acre equivalent to 2 lb a.i/acre of formulated Topsin M 70W.**
*** No vegetation was not analyzed for residue.**
*** Data on plot area slope, depth to water table, climatological data, and storage stability data were reported in this study. Topsin M 70W. A 10 year monthly average rainfall for the study site was not provided in this study.**
*** At this time EFED believes that this study was conducted properly and produce results that are not different from laboratory studies in regard to the behavior of thiophanate-methyl.**

APPENDIX 6, ECOLOGICAL EFFECTS CHARACTERIZATION

Ecological Toxicity Data

Toxicity to Terrestrial Animals

Birds, Acute and Subacute

An acute oral toxicity study using the technical grade of the active ingredient (TGAI) is required to establish the toxicity of thiophanate-methyl to birds. The preferred test species is either mallard duck (a waterfowl) or bobwhite quail (an upland gamebird). Results of this test are tabulated below.

Avian Acute Oral Toxicity

Species	% ai	LD50 (mg/kg)	Toxicity Category	MRID No. Author/Year	Study Classification[1]
Northern bobwhite quail *(Colinus virginianus)*	94	>4640	practically nontoxic	00083012, 1977	Core
Mallard duck *(Anas platyrhynchos)*	94	4640	practically nontoxic	NAOTH101, 1977	Core

[1] Core (study satisfies guideline). Supplemental (study is scientifically sound, but does not satisfy guideline)

Since the LD50 falls in the range of 4640 mg/kg, thiophanate-methyl is categorized as parctically nontoxic to avian species on an acute oral basis. The guideline (71-1) is fulfilled (MRID Nos. 00083012 and NAOTH101).

Two subacute dietary studies using the TGAI are required to establish the toxicity of thiophanate-methyl to birds. The preferred test species are mallard duck and bobwhite quail. Results of these tests are tabulated below.

Avian Subacute Dietary Toxicity

Species	% ai	5-Day LC50 (ppm)[1]	Toxicity Category	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	94	>10,000	practically nontoxic	00069600, 1977	Core
Mallard duck *(Anas platyrhynchos)*	94	>10,000	practically nontoxic	00083014, 1975	Core

[1] Test organisms observed an additional three days while on untreated feed.

Since the LC_{50} falls in the range of 10,000 ppm, thoiphanate-methyl is categorized As practically nontoxic to avian species on a subacute dietary basis. The guideline (71-2) is fulfilled (MRID Nos 00069600 and 00083014).

Birds, Chronic

Avian reproduction studies using the TGAI are required for thiophanate-methyl because the following conditions are met: (1) birds are subject to repeated or continuous exposure to the pesticide, especially preceding or during the breeding season, (2) the pesticide is stable in the environment to the extent that potentially toxic amounts may persist in animal feed, (3) the pesticide may accumulate in plant or animal tissues, and/or, (4) information derived from mammalian reproduction studies indicates reproduction in terrestrial vertebrates may be adversely affected by the anticipated use of the product. The preferred test species are mallard duck and bobwhite quail. Results of these tests are tabulated below.

Avian Reproduction

Species/ Study Duration	% ai	NOAEC/LOEC (ppm)	LOAEC Endpoints	MRID No. Author/Year	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	94	>150	no effects	NAOTH102, 1978	Core
Northern bobwhite quail *(Colinus virginianus)*	95.93%	>500	no effects	429307-01, 1993	Core
Mallard duck *(Anas platyrhynchos)*	96	>103	eggs & body wt.	424748-01, 1992	Core

Analysis of results indicate that there were no egg production, growth or survival effects on the bobwhite quail for dosage levels tested. However, there were pesticide relative effect on the mallard duck egg production and body weight at the highest dosage level tested only.

The guideline (71-4) is fulfilled (MRID Nos. NAOTH102, 429307-01 and 424748-01).

Mammals, Acute and Chronic

Wild mammal testing is required on a case-by-case basis, depending on the results of lower tier laboratory mammalian studies, intended use pattern and pertinent environmental fate characteristics. In most cases, rat or mouse toxicity values obtained from the Agency's Health Effects Division (HED) substitute for wild mammal testing. These toxicity values are reported below.

Mammalian Toxicity (rat)

Species/ Study Duration	% ai	Test Type	Toxicity Value	Affected Endpoints	MRID No.
laboratory rat *(Rattus norvegicus)*	*96.55*	*LD50*	*>5,000*		*416443-01*
Laboratory mouse *(Mus musculus)*	96.55	Repro., male	195 mg/kg, LOAEL	liver & body wt loss	426077-01

An analysis of the results indicate that thiophanate-methyl is categorized as practically nontoxic to small mammals on an acute oral basis.

Insects

A honey bee acute contact study using the TGAI is required for thiophanate-methyl because its use **(list sites)** will result in honey bee exposure. Results of this test are tabulated below.

Nontarget Insect Acute Contact Toxicity

Species	% ai	LD50 (Fg/bee)	Toxicity Category	MRID No. Author/Year	Study Classification
Honey bee *(Apis mellifera)*	96.2	>100 ug/bee	relative nontoxic	400532-09, 1986	Core

An analysis of the results indicate that thiophanate-methyl is categorized relative nontoxic to bees on an acute contact basis. The guideline (141-1) is fulfilled (MRID No. 400532-09).

A honey bee toxicity of residues on foliage study using the typical end-use product is not required for thiophanate-methyl even though its use *(list sites)* will result in honey bee exposure, however, the acute contact honey bee LD50 is >100 *ug*/bee. Results of this test show that the guideline (141-2) is fulfilled (MRID No. 400532-09).

Terrestrial Field Testing

None

Toxicity to Freshwater Animals

Freshwater Fish, Acute

Two freshwater fish toxicity studies using the TGAI are required to establish the toxicity of thiophanate-methyl to fish. The preferred test species are rainbow trout (a coldwater fish) and bluegill sunfish (a warmwater fish). Results of these tests are tabulated below.

Freshwater Fish Acute Toxicity

Species/ Flow-through or Static	% ai	96-hour LC50 (ppm) (measured/nominal)	Toxicity Category	MRID No. Author/Year	Study Classification
Rainbow trout *(Oncorhynchus mykiss)* static	Tech.	8.3	Moderately toxic	000505-16, 1971	Suppl.
Bluegill sunfish *(Lepomis macrochirus)*	97.6	>41	slightly toxic	421235-01, 1991	Core

Since the LC50 falls in the range of 8.3 to >41 ppm, thiophanate-methyl is categorized as moderately to slightly toxic to freshwater fish on an acute basis. The guideline (72-1) is fulfilled (MRID Nos. 000505-15 and 421235-01).

Freshwater Fish, Chronic

A freshwater fish early life-stage test using the TGAI is required for MBC to determine if chronic LOC is exceeded at the registered maximum application rates.

Freshwater Fish Chronic Toxicity

Species/ Flow-through or Static	% ai	NOAEC (ppm) (measured/nominal)	End-point	MRID No. Author/Year	Study Classification
Channel Catfish *(Ictalurus punctatus)*	99.3 MBC	0.002	Larvae Survival	438728-01, 1995	Core

The guideline (72-4, Freshwater Fish Full life stage is fulfilled MRID No. 438728-01

Freshwater Invertebrates, Acute

A freshwater aquatic invertebrate toxicity test using the TGAI is required to establish the toxicity of thiophantae-methyl to aquatic invertebrates. The preferred test species is *Daphnia magna*. Results of this test are tabulated below.

Freshwater Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai	48-hour LC50/ EC50 (ppm) (measured/nominal)	Toxicity Category	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna*)	97.57% Tech	5.4	Moderately toxic	42298101	Core
Waterflea *(Daphnia magna)*	98 MBC	5.4	Moderately toxic	425294-01	Core

Since the LC50/EC50 falls in the range of 5.4 ppm, thiophanate-methyl is categorized as

moderately toxic to aquatic invertebrates on an acute basis. The guideline (72-2) is fulfilled (MRID No. 42298101).

Freshwater Invertebrate, Chronic

Freshwater Invertebrate Chronic Toxicity

Species/Static or Flow-through	% ai	NOAEC(ppm)	End-point	MRID No. Author/Year	Study Classification
Waterflea *(Daphnia magna)*	99 MBC	0.003	survival	4229881-01, 1993	Core

The guideline (72-4, *Daphnia magna*) is fulfilled MRID No. 425294-01

Freshwater Field Studies

None

Toxicity to Estuarine and Marine Animals

Estuarine and Marine Fish, Acute

Acute toxicity testing with estuarine/marine fish using the TGAI is required for because the end-use product is intended for direct application to the marine/estuarine environment or the active ingredient is expected to reach this environment because of its use in coastal counties. The preferred test species is sheepshead minnow. Results of these tests are tabulated below.

Estuarine/Marine Fish Acute Toxicity

Species/Static or Flow-through	% ai	96-hour LC50 (ppm) (measured/nominal)	Toxicity Category	MRID No. Author/Year	Study Classification
Sheepshead minnow *(Cyprinodon variegatus)*	97.6	40, NOAEC = 17	slightly toxic	421235-03	Core

Since the LC50 falls in the range of 40 ppm, thiophanate-methyl is categorized as slightly toxic to estuarine/marine fish on an acute basis. The guideline (72-3a) is fulfilled (MRID No. 421235-03).

Estuarine and Marine Fish, Chronic

The guideline (72-4) is not fulfilled due lack of data
The guideline (72-5) is not fulfilled due to lack of data

Estuarine and Marine Invertebrates, Acute

Acute toxicity testing with estuarine/marine invertebrates using the TGAI is required for thiophanate-methyl because the active ingredient is expected to reach this environment because of its use in coastal counties. The preferred test species are mysid shrimp and eastern oyster. Results of these tests are tabulated below.

Estuarine/Marine Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai.	96-hour LC50/EC50 (ppm) (measured/nominal)	Toxicity Category	MRID No. Author/Year	Study Classification
Eastern oyster (shell deposition or embryo-larvae) *(Crassostrea virginica)*	90.1	2.2	Moderately toxic	420946-02, 1991	Suppl.
Mysid *(Americamysis bahia)*	97.5	1.1	Moderately toxic	42123502, 1991	Suppl.

Since the LC50/EC50 falls in the range of 1.1 to 2.2 ppm, thiophanate-methyl is categorized as moderately toxic to estuarine/marine invertebrates on an acute basis. The guideline (72-3b and 72-3c) is fulfilled (MRID Nos. 421235-02 and 420946-02).

Estuarine and Marine Invertebrate, Chronic

An estuarine/marine invertebrate life-cycle toxicity test is required because TM is expected to transport to, estuarine/marine sites and 1) exposure of aquatic organisms will be continual or recurred; 2) the lowest EC50 is 1 mg/L or less; 3) the EEC in water is equal to or greater than 0.01 of any EC50; 4) the EEC is less than any EC 50, and 5) the product has reproductive effects. The results are calculated below.

Estuarine/Marine Invertebrate Chronic Toxicity

Species/Static or Flow-through	% ai.	NOAEC (PPM)	Toxicity Category	MRID No. Author/Year	Study Classification
Mysid *(Americamysis bahia)*	99.3	0.025	survival	427237-01, 1992	Core

The guideline (72-4) is fulfilled (MRID No. 427237-01).

Estuarine and Marine Field Studies

None

Toxicity to Plants

Terrestrial Plants

For seedling emergence and vegetative vigor testing the following plant species and groups should be tested: (1) six species of at least four dicotyledonous families, one species of which is soybean (*Glycine max*) and the second is a root crop, and (2) four species of at least two monocotyledonous families, one of which is corn (*Zea mays*).

Tier I tests measure the response of plants, relative to a control, at a test level that is equal to the highest use rate (expressed as lbs ai/A). Tier I tests were conducted using technical TM: MRID4404101 and 42123504 for seedling emergence and vegetative vigor respectively. The maximum dosage tested was 1.4 lbs. ai per acre. These data are not useful for risk assessment purposed because the maximum label dose was not evaluated. Labeled crops not covered by the 1.4 lb per acre dosage are ornamentals - 100 lbs. ai per acre, turf - 44 lbs. ai per acre, onions - 11.2 lbs. ai per acre, and and peaches - 1.58 lbs. ai per acre. These data indicate that 3 of the 10 crop plants tested at 1.4 lbs. ai per acre were more sensitive than the others: cucumber, tomato, and soybean.

Additional seedling emergence and vegetative vigor studies are required using the proper dosages and the TEP.

Aquatic Plants

Results of Tier II toxicity testing using technical TM are tabulated below.

Nontarget Aquatic Plant Toxicity (Tier II)

Species	% ai	EC50/ EC05 (ppm)	MRID No. Author/Year	Study Classification
Vascular Plants				
Duckweed *Lemna gibba*	97.6	>4.70 NOAEC - 4.70	421235-05	Core
Nonvascular Plants				
Green algae *Kirchneria subcapitata*	97.6	>0.95 NOAEC - 0.95	422298-01	Core
Marine diatom *Skeletonema costatum*	97.6	1.7 NOAEC - 0.11	422298-03	Core
Freshwater diatom *Navicula pelliculosa*	97.6	0.93 NOAEC- 0.43	422298-02	Core
Blue-green algae *Anabaena flos-aquae*	97.6	>4.3 NOAEC - 4.30	422981-02	Core

The Tier II results indicate that freshwater diatom is the most sensitive aquatic plant. The guideline (123-2) is fulfilled (MRID Nos. 421235-05, 422298-01, 422298-02, 422298-03, 422981-02).

APPENDIX 7, RISK QUOTIENTS AND LEVELS OF CONCERN

Exposure and Risk Characterization

Risk characterization integrates the results of the exposure and ecotoxicity data to evaluate the likelihood of adverse ecological effects. The means of this integration is called the quotient method. Risk quotients (RQs) are calculated by dividing exposure estimates by acute and chronic ecotoxicity values.

RQ = EXPOSURE/TOXICITY

RQs are then compared to OPP's levels of concern (LOCs). These LOCs are used by OPP to analyze potential risk to nontarget organisms and the need to consider regulatory action. The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on nontarget organisms. LOCs currently address the following risk presumption categories: (1) **acute high** -- potential for acute risk is high; regulatory action may be warranted in addition to restricted use classification, (2) **acute restricted use** -- the potential for acute risk is high, but may be mitigated through restricted use classification, (3) **acute endangered species** - endangered species may be adversely affected, and (4) **chronic risk** - the potential for chronic risk is high regulatory action may be warranted. Currently, EFED does not perform assessments for chronic risk to plants, acute or chronic risks to nontarget insects, or chronic risk from granular/bait formulations to birds or mammals.

The eco-toxicity test values (ie, measurement endpoints) used in the acute and chronic risk quotients are derived from required studies. Examples of eco-toxicity values derived from short-term laboratory studies that assess acute effects are: (1) LC50 (fish and birds), (2) LD50 (birds and mammals), (3) EC50 (aquatic plants and aquatic invertebrates) and (4) EC25 (terrestrial plants). Examples of toxicity test effect levels derived from the results of long-term laboratory studies that assess chronic effects are: (1) LOAEC (birds, fish, and aquatic invertebrates), (2) NOAEC (birds, fish and aquatic invertebrates), and (3) MATC (fish and aquatic invertebrates). For birds and mammals, the NOAEC generally is used as the eco-toxicity test value in assessing chronic effects, although other values may be used when justified. Generally, the MATC (defined as the geometric mean of the NOAEC and LOAEC) is used as the eco-toxicity test value in assessing chronic effects to fish and aquatic invertebrates. However, the NOAEC is used if the measurement end point is production of offspring or survival.

Risk presumptions and the corresponding RQs and LOCs, are tabulated below.

Risk Presumptions for Terrestrial Animals

Risk Presumption	RQ	LOC
Birds		
Acute High Risk	EEC[1]/LC50 or LD50/sqft[2] or LD50/day[3]	0.5
Acute Restricted Use	EEC/LC50 or LD50/sqft or LD50/day (or LD50 < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC50 or LD50/sqft or LD50/day	0.1
Chronic Risk	EEC/NOAEC	1
Wild Mammals		
Acute High Risk	EEC/LC50 or LD50/sqft or LD50/day	0.5
Acute Restricted Use	EEC/LC50 or LD50/sqft or LD50/day (or LD50 < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC50 or LD50/sqft or LD50/day	0.1
Chronic Risk	EEC/NOAEC	1

[1] abbreviation for Estimated Environmental Concentration (ppm) on avian/mammalian food items
[2] mg/ft^2 [3] mg of toxicant consumed/day
LD50 * wt. of bird LD50/ wt. of bird

Risk Presumptions for Aquatic Animals

Risk Presumption	RQ	LOC
Acute High Risk	EEC[1]/LC50 or EC50	0.5
Acute Restricted Use	EEC/LC50 or EC50	0.1
Acute Endangered Species	EEC/LC50 or EC50	0.05
Chronic Risk	EEC/MATC or NOAEC	1

[1] EEC = (ppm or ppb) in water

Risk Presumptions for Plants

Risk Presumption	RQ	LOC
	Terrestrial and Semi-Aquatic Plants	
Acute High Risk	EEC[1]/EC25	1
Acute Endangered Species	EEC/EC05 or NOAEC	1
	Aquatic Plants	
Acute High Risk	EEC[2]/EC50	1
Acute Endangered Species	EEC/EC05 or NOAEC	1

[1] EEC = lbs ai/A
[2] EEC = (ppb/ppm) in water

APPENDIX 8: EXPOSURE AND RISK TO NON-TARGET TERRESTRIAL ANIMALS

For pesticides applied as a nongranular product (*e.g.*, liquid, dust), the estimated environmental concentrations (EECs) on food items following product application are compared to LC50 values to assess risk. The predicted 0-day maximum and mean residues of a pesticide that may be expected to occur on selected avian or mammalian food items immediately following a direct single application at 1 lb ai/A are tabulated below.

Estimated Environmental Concentrations on Avian and Mammalian Food Items (ppm) Following a Single Application at 1 lb ai/A)

Food Items	EEC (ppm) Predicted Maximum Residue[1]	EEC (ppm) Predicted Mean Residue[1]
Short grass	240	85
Tall grass	110	36
Broadleaf/forage plants and small insects	135	45
Fruits, pods, seeds, and large insects	15	7

[1] Predicted maximum and mean residues are for a 1 lb ai/a application rate and are based on Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994).

APPENDIX 9: AVIAN RISK ASSESSMENT CAVEATS

Factors that suggest risk assessment may underestimate risk to birds:

1) Only one out of hundreds of bird species are tested. Other species are likely to be much more sensitive. Avian toxicity tests are also used to assess risk to reptiles.

2) Other route of exposure are not evaluated during acute toxicity studies such as through contaminated drinking water and soil, dermal, inhalation, and preening.

3) In dietary LC50studies birds are exposed to pesticides for five days. In the environment, birds are potientally exposed to pesticides for more than five days.

4) In acute oral LD50 studies adult birds are exposed. Young birds are often more sensitive than adults.

5) The caloric content in the laboratory test feed is higher than in avian food items in the field. Birds under laboratory conditions in the LC50 dietary study consume a much lower proportion of their body weight each day than birds in the wild. Therefore, birds in the laboratory consume a lower amount of test material in their food than birds do in the wild.

6) Birds in the wild may consume food at a quicker rate than birds in the laboratory.

7) Streses to bird in the wild such as heat, cold, disease, parasites, malnutrition,avoiding predators, finding food, and migration may effect toxiciry and are not measured in the laboratory.

9) Birds in the wild are exposed to multiple pesticides at once. The toxicity may be additive or even synergistic. In laboratory they are exposed to just one pesticide.

10) Some pesticies from degradation products that are more toxic than the parent compounds. These are not generally tested in acute toxicity studies.

11) For multiple applications, risk is calculated for a single point in time. The risk quotients do not address the accumulation iof acute risk over time.

12) Only a relatively small number of potential endpoint are measured in avian reproduction studies. Endocrine disruption effects on second generation birds are not measured. Mating behavior and egg shell strength are also not meassured.

13) The laboratory test has low power to detect reproductive effects. A more sensitive study (i.e. using more replicates and less variaility) would likely detect significant effects at lower test concentrations.

13) Eggs in the laboratory are not exposed to pesticides. Eggs in the nests in the wild may be exposed to pesticides (and aromatic hydrocarbon in formulations) during over spraying and through contact with parent birds during incubation periods.

14) Short tern exposure to peak residue levels may result in reproductive effects. Use of degradation rate estimates in chronic exposure models may not be appropriate.

15) Indirect effect of pesticides on wildlife food sources such as aquatic invertebrates, seeds, and vegetation are not taken into consideration in risk indices.
Redraft, R. Petrie, 2/13/01.